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VOLUME LXXVIII

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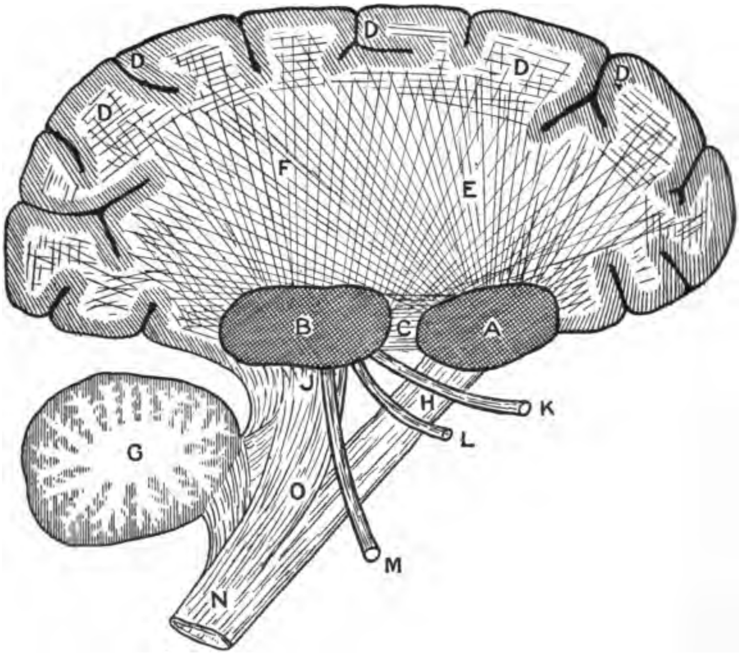
Diagram showing the Relation the Centres of Memory bear to the Other Parts of the Brain.



A. Corpus Striatum (centre of motor memory).
B. Optic Thalamus (centre of sensory memory).
C. Fibres of the direct connection.
D. Gray matter of the cerebral hemispheres (seat of the faculties of the mind).
D′. Fibres connecting the various faculties.
E. Fibres connecting the faculties with the motor memory.
F. Fibres connecting the faculties with the sensory memory.
G. Cerebellum.
H. Motor nerves arising from corpus striatum.
J. Sensory nerves terminating in optic thalamus.
K, L, M. Olfactory, optic, and auditory nerves terminating in optic thalamus.
N. Medulla Oblongata.
O. Pons Varolii.

THE INTERNATIONAL SCIENTIFIC SERIES

MEMORY AND ITS CULTIVATION

BY

F. W. EDRIDGE-GREEN, M.D., F.R.C.S.

AUTHOR OF
COLOUR BLINDNESS AND COLOUR PERCEPTION, ETC.

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PREFACE

ONE of the most marked features of the present age is the invention of labour and time saving appliances; it is evident that time saved is time gained. In an age which is specially characterised by intellectual progress, much time must necessarily be expended in the acquirement of knowledge, which will serve as a basis for further development. I hope, therefore, that any rules which will lighten labour in this direction will be found useful. After discovering the facts which led me to write on the subject of Memory, I found that I could learn a subject in about a fifth of the time that it previously took me. I hope that those who read this book will be able to improve their memories in a corresponding degree.

F. W. EDRIDGE-GREEN.

6 RAVENSFIELD VILLAS,
HENDON, N.W.

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PART II

MEMORY

AND ITS CULTIVATION

CHAPTER I

INTRODUCTION

WHAT is MEMORY? It is the process by means of which impressions of the external world and ideas are retained for use on future occasions.

Memory is the most important function of the brain; without it life would be a blank. Our knowledge is all based on memory. Every thought, every action, our very conception of personal identity, is based on memory. Without memory, all experience would be useless; reasoning would be based on insufficient data, and would be, therefore, fallacious. A bad memory makes an otherwise able man appear foolish; he looks his acquaintances in the face without recognising them; he forgets his appointments; and though he may be well acquainted with the ordinary rules of society, he forgets what to do under particular circumstances.

Memory must be clearly distinguished from remembrance and recollection. Recollection is the power of

voluntarily recalling impressions. Remembrance is the term applied when the process is involuntary. Memory is the innate power to have an impression recalled if a proper stimulus be applied.

Who has not, when revisiting the scenes of early childhood, had circumstances come back to his mind with a vividness which has astonished him? Many cases have been recorded, of men who have been saved from drowning, who have seen all the incidents of their past life, as it were in a panorama, and with the minutest details. It is clear that these events could not have been forgotten in the true sense of the word, for if they had been, no stimulus, however strong, would have been able to bring them before the consciousness. In this way the circle of remembrance can be widened; an impression, which cannot be revived by a weak stimulus, will at once occur to the mind should one of the elements of a strong association be presented. From this it will be seen how little is really forgotten, the most trivial incidents being remembered when the same circumstance occurs again with exactly similar surroundings.

Many psychologists hold the view that when anything is known so well as to become an integral part of ourselves, then there is no memory in the process of remembrance. They say, 'we do not remember that a stone is hard.' It seems to me that if we *forgot* that important circumstance, we should be reminded of it in a most disagreeable way on striking against one.

How little do men think, when they say that 'they cannot remember anything,' how much they really do remember! A person's knowledge of himself, as a being, is based on memory; he would not be able to

recognise his own reflection in a mirror if it were not for memory. The extent of this faculty is clearly shown under circumstances in which it is temporarily or permanently in abeyance, as in some pathological conditions. There is no process of the mind which is not primarily based on memory. Even in listening to an ordinary conversation, memory is required; for, in its absence, we should forget the first portion of a sentence before we had heard the conclusion.

If it were not for memory, our native tongue would be as unintelligible as a foreign language is to most persons. We feel that there is a distinct difference between easy remembrance and attempted recollection. In the process of remembrance much less nervous force is expended: there is very little mental labour involved, in reading a novel or watching a theatrical performance, but the number of previous impressions which are revived, is enormous. How different it is when we try to recollect a name which has been forgotten; we feel that the mental labour is comparatively severe.

Then the most superficial observer must have noticed that persons differ in what they remember; one remembers tunes, but forgets words; another remembers words, but forgets shapes, and so on.

(The word 'forget' is used here and throughout the following pages, not as having the meaning of an impression having become irretrievably lost, but that the power of recalling it has become temporarily or permanently lost.)

In the following pages I shall demonstrate that memory is a definite faculty, and has its seat in the basal ganglia of the brain, separate from, but associated with, all the other faculties of the mind.

CHAPTER II

THE DIVISIONS OF MEMORY

MEMORY is primarily divided into sensory and motor, corresponding to the sensory and motor nerves.

In the centre for sensory memory all impressions received through the nerves of sight, hearing, smell, taste, touch, and all other impressions conveyed by the sensory nerves to the mind, are stored up. The memory of all ideas, emotions, and other processes of the mind arising out of the sensory memory impressions, also forms part of the sensory memory.

These primary divisions of memory each contain numerous subdivisions depending upon the fact that the faculties of the mind vary in individuals, it being very rare to find two persons with exactly similar characters. As the hereditary tendencies, education, and surroundings, have the effect of causing each person to have his special desires and pursuits, he has in conformity with them special memories, which are developed by special intensifications of certain portions of the general memory. These special memories can be arranged in groups, as the special memory for forms, the special memory for tunes, or the special memory for articulate sounds.

The motor memory is the memory that is required

for the performance of muscular movements that have to be learned.

There are, therefore, two chief divisions of memory, each containing numerous subdivisions.

1. The general memory of all sensory impressions, both external and internal—GENERAL SENSORY MEMORY.

This is subdivided into the memories consisting of groups of specially intensified constituents of the general sensory memory, formed by the action of particular faculties of the mind—THE SPECIAL SENSORY MEMORIES.

2. The memory required for the continued performance of coördinated muscular movements—GENERAL MOTOR MEMORY.

This is subdivided into the memories consisting of specially intensified portions of the motor memory required for the performance of definite actions—THE SPECIAL MOTOR MEMORIES.

Sensory memory has only to deal with sensory impressions, motor memory with those motor impulses from the brain which are required to bring about a voluntary movement. It is from ideas, derived from sensory memory impressions, that movements are attempted; but it is by means of the motor memory that these movements are performed with increasing rapidity and with less attention. The following example will show how special sensory memories differ in individuals, and the relation they bear to one another.

Let us suppose that there were several persons on the top of the Monument, looking at London. A coloured photograph would represent the view, fairly well. The general impression would be the same; thus, most

would agree that the photograph was an accurate representation of what they saw. But if each of these persons, previously to seeing the photograph, had given a description of the view, the following would have been the probable result:

The man of a low intellectual type, whose principal object in going up the Monument was that of being able to say that he *had* done so, would probably recollect absolutely nothing. When he was on the Monument he *observed* nothing in particular.

The man of observation, who can remember what he *sees*, would examine the details of the scene and *notice* the various buildings, a process which is quite distinct from mere seeing, insomuch as it consists in bringing the mind to bear upon an impression in the centre for the sensory memory. Then if he were asked to describe what he had seen, he would think of how the buildings looked, and what he had recognised, and so remember the whole.

Another man, who had a good memory for the relative positions of objects, would notice the relation which the various streets and buildings had to one another. For instance, that the river was on his left hand, Cannon Street Terminus on the right, St. Margaret's Church behind, and so on. When asked, some time afterwards, 'Did you see St. Dunstan's Church?' he would try to think of the relation the churches had to the other buildings, and would answer, 'Yes; it lay between the Monument and the Tower'

An architect would criticise the construction of the town, especially anything connected with his business, such as faulty architecture, erratic bridges, and so on. He would remember them by the errors or improve-

ments which suggested themselves to his mind at the time of observing them.

A historian would recall to his mind facts and incidents connected with the various objects that he saw. Thus, on being asked if he had seen William IV.'s statue, he would reply, 'Oh yes; it occupies the site of the old Boar's Head, mentioned by Shakespeare as the place where Falstaff used to drink.'

A geologist, a sailor, a schoolmaster, and an artist, would each remember different portions of the view: they would each notice the objects that they were specially acquainted with, and overlook those with which they were not familiar. It may be said, that the particular profession or business, in the above-mentioned instances, is sufficient to account for the different descriptions given by each, but it must be remembered that, in the majority of cases, it is the possession of certain predominating faculties, that leads an individual to select a certain profession or business, in preference to others; a cowardly man would never voluntarily become a soldier, or a man who found a difficulty in mastering the multiplication table, an accountant. A man who was colour-blind might make a very good engraver or sculptor, but would be a failure as an artist.

The foregoing examples are sufficient to show how memory differs in individuals. If any half-dozen persons were to read the same book, or look at the same pictures together, and then each write a detailed account of the same, the above-mentioned differences would be found.

The above instances could be multiplied indefinitely, each faculty, intellectual, moral, or emotional, when pre-

dominating, influencing the possessor to notice those things which, as it were, 'supply those faculties.' This clearly distinguishes between general and special memory, the latter being the special groups of impressions obtained by the influence of particular faculties of the mind. How the faculties build up these special memories will be discussed at length in a future chapter.

Then, supposing a coloured photograph to represent the general memory-impression, all the varieties and shades of colour will represent one special memory group of impressions, the forms of the objects another group, and so on.

It now only remains to distinguish between general and special motor memory. The memory of all movements, no matter for what purpose produced, belongs to general motor memory, whilst the specially intensified memory required for the performance of certain definite actions is special motor memory. For example, the motor memory required for the performance on a musical instrument is one variety of special motor memory; the motor memory required to skate, ride, dance, speak, or write, other varieties, being special portions of the general motor memory required for a definite purpose, and influenced by several faculties, which vary according to the variety produced.

CHAPTER III

SENSORY MEMORY

SENSORY memory depends absolutely upon the sensory impressions received, as elaborated by the sensory nerves; we have cognizance of the world (probably only in part as it really exists) as our senses inform us of its existence. The senses allow of a certain amount of substitution, one for the other, but each has its special function, which cannot be replaced by any of the others. Thus the ear takes no account of light, neither does the eye have cognizance of sound; so we can never judge of bodies as material substances otherwise than by the senses we possess; in fact, it seems difficult to conceive how bodies could possess properties which we are not able to recognise by the senses we have; but the study of science shows that such is the case. An illustration will better explain this. It is impossible to explain to a man who has been born blind what sight is; he is unable to appreciate what such a sense can be, and so does not feel the want of it in the same way as a man who has once been possessed of sight. It is the same with a person who has been born without the sense of smell; he is quite unable to conceive what such a sense can be, and does not feel its want. A man who has been born deaf and dumb can have no ideas of sound. A very common instance is that of a myope who has

never looked through an appropriate concave glass. He knows that his companions are able to see better than he does, because they are able to recognise an acquaintance at a much greater distance; but he is unable to conceive the *real* difference between himself and them, simply because he is only able to reason on the impressions he possesses. He is astounded when he looks through a glass adapted to his vision for the first time. It is a revelation to him. The name applied to them has caused many persons to confuse two distinct classes of impressions, namely, those which we gain of the form of an object by sight, and those which we gain by touch. These are as essentially different from each other as form is from colour. By sight we gain ideas of form as represented in a photograph, and are perfectly able to judge of the form of an object by means of a photograph, which a blind man could not do. The idea of solidity, which is the essential of an impression conveyed by touch, is not a property of sight at all, but depends upon the revival of ideas of objects previously formed, and the effect on the mind of the differences in the impressions received by the two eyes. This may easily be proved by shutting one eye and looking at an object the converse of which is as familiar to the mind as the object itself, as a cameo. With one eye shut it will be impossible to distinguish a cameo from an intaglio, when, by touch, it would be instantly done.

The idea of solidity which is formed on looking at a picture with one eye, all surroundings which might negative this idea being excluded, is due to the revival of previous impressions. The stereoscope shows clearly how two photographs, taken in such a way as to correspond to the impressions which would be received on the

retina of a person looking at the view, give an idea of solidity. That this idea of solidity is a matter of judgment was well shown by a photograph of a marble statue which I had an opportunity of seeing at a late exhibition. It was impossible not to believe that a marble statue was being looked at. The photograph was at the end of a room, and lighted on both sides, and not looked at through glass, nor the ordinary vision interfered with in any way. It will thus be seen that ideas of form gained by the sense of sight are essentially distinct from those derived by touch, and it is as impossible to explain to a congenitally blind man how form can be represented on a *plane surface* as it is to give him any ideas of colour.

Much surprise has been expressed by many psychologists on finding that a person who has been born blind, having gained his sight by an operation, has failed to recognise objects by sight which he was perfectly cognizant with by touch. This we should expect, as, from what has been previously said, if a cameo represent the impression of touch, a coloured photograph of that cameo will represent the impression of sight.

The following case recorded by Cheselden illustrates this:

'A youth, about twelve years old, who had been born blind, but had obtained his sight by an operation, for some time after tolerably distinct vision had been obtained, saw everything *flat*, as in a picture, simply receiving the consciousness of the impression made upon his retina; and it was some time before he acquired the power of judging by his sight of the *real* forms and distances of the objects around him. An amusing anecdote recorded of him shows the complete want

which there is in man of any *original* or *intuitive* connection between the ideas formed through visual and through tactile sensations. He was well acquainted with a dog or cat by *feeling*, but could not remember their respective characters when he *saw* them; and one day, when thus puzzled, he took up the cat in his arms, and felt her attentively, so as to associate the two sets of cognitions, and then, setting her down, said, 'So, puss, I shall know you another time."'

Another very excellent example is recorded by Critchett in the 'Medico-Chirurgical Transactions,' vol. xxxviii., of a young woman who had been blind from her birth, but had obtained her sight by an operation:

'I found,' says the operator, 'that she was never able to ascertain what an object really was by sight alone, although she could correctly describe its shape and colour; but that after she had once instructed one sense through the medium of the other, and compared the impressions conveyed by touch and sight, she was ever after able to recognise the object without touching it. In this respect her memory was very perfect; I never knew her fail in a single instance, though I put this power frequently to the test of experiment. It was curious to place before her some very familiar object that she had never compared in this way, such as a pair of scissors. She would describe their shape, colour, glistening metallic character, but would fail in ascertaining what they really were until she put a finger on them, when in an instant she would name them, and laugh at her own stupidity, as she called it, in not having made them out before.'

So the remembrance of an impression is in accord-

ance with that impression; thus when an afferent impression has been received in the centre for sensory memory, it produces such a modification of the protoplasm of the ganglion cells there, as to allow the complete impression to be brought before the consciousness, when the attention is brought to bear upon the subject. This modification of the protoplasm is permanent, only varying in intensity with time, *and constitutes the sensory memory.* This diminution in the intensity of the impression is well exemplified in the following way. If a person of average ability, directly after having looked at a picture or a photograph, close his eyes and think of the picture, the remembrance of it will be almost as vivid as the sensory impression itself; if the observer had waited for a minute or two before trying to think of the picture, the remembrance would have been less vivid; in a day feeble, in a week of still less intensity, the remembrance varying with individuals, some being able to have a fair remembrance of the picture, others failing to have the slightest recollection of it.

But, besides the memory of external impressions, there is the memory of internal impressions, that is, the remembrance of thoughts, perceptions, and the other processes of the mind. Thus, when looking at the picture, various ideas usually occur to the observer, and when thinking of it again he remembers these ideas. Every idea and thought which occurs to the mind, depends primarily upon some external influence, however much it may be altered from the original. This forms an important class of impressions, only differing in this, that instead of being received and elaborated by the sensory nerves and their centres, and conducted

upwards to the centres for sensory memory, they are originated by the higher parts of the brain, and conducted downwards to the centre.

Thus, there are two divisions of sensory memory:

1. That memory which consists of the modification of the protoplasm of the cells of the centre, produced by sensory impressions as received.

2. That memory which consists of the modification of the protoplasm of the cells of the centre, produced by impressions of thoughts and ideas based on sensorial impressions.

Our knowledge of the external world is all based on impressions conveyed to the brain by the sensory nerves, which convey a larger number of impressions than are included under the names of the special senses, sight, hearing, smell, touch, and taste; thus, we also receive impressions of the condition of the muscles, temperature, visceral and pathological sensations.

No impression which has ever been brought before the mind, whether originated by any object in the external world, or by the action of any of the faculties, is ever entirely lost.

This necessarily follows, assuming the process of memory described above to be true, namely, that memory consists of the modification of the protoplasm of the receptive cells produced by an impression, the intensity of the modification only diminishing with time. The change in the protoplasm which constitutes memory can only take place in cells having an original construction fitted for the purpose, in the same way as only the cells of the retina can respond to light. All cells undergo modifications when submitted to certain influencing conditions; but these modifications do not

constitute memory, neither does that increased functional activity which results from stimulation when not excessive.

As an impression must reach a certain sum of intensity before it is brought before the consciousness, the greater number of impressions never become revived, because this intensity is not attained. They remain in a latent condition, waiting for an appropriate stimulus for their revival to take place. How often the most trivial incidents are brought back, by some strong resemblance or association—events and details so far forgotten, that if narrated by others, they would not have been recognised as having occurred.

There are very few persons, excepting perhaps the most feeble-minded individuals, who are not able to recognise an anecdote when told with all its details by another a second time, at a comparatively short period after the first recital, though they might not have been able to repeat it correctly themselves. If the original modification of the protoplasm caused by the anecdote had disappeared, then no stimulus, however strong, would be able to bring it back to the mind. It is very rare for a person not to remember an occurrence if he be placed in exactly the same circumstances as when he received the original impression.

The following are instances of the revival of old impressions. Numerous cases might be given, as examples of this class are very common:

1. 'Several years ago, the Rev. S. Hansard, now rector of Bethnal Green, was doing clerical duty for a time at Hurstmonceaux, in Sussex; and while there he one day went over with a party of friends to Pevensey Castle, which he did not remember to have ever pre-

viously visited. As he approached the gateway, he became conscious of a very vivid impression of having seen it before; and he seemed to himself to see not only the gateway itself, but donkeys beneath the arch, and people on top of it. His conviction that he must have visited the Castle on some former occasion—although he had not the slightest remembrance of such a visit, nor any knowledge of having been in the neighbourhood previously to his residence at Hurstmonceaux—made him inquire from his mother if she could throw any light on the matter. She at once informed him that, being in that part of the country when he was about eighteen months old, she had gone over with a large party, and had taken him in the pannier of a donkey; that the elders of the party having brought lunch with them, had eaten it on the roof of the gateway, where they would have been seen from below; whilst he had been left on the ground with the attendants and donkeys. This case is remarkable for the vividness of the sensorial impression (it may be worth while to notice that Mr. Hansard has a decidedly artistic temperament) and for the reproduction of details which were not likely to have been brought up in conversation, even if he had happened to hear the visit itself mentioned as an event of his childhood, and of such mention he has no remembrance whatever.'—CARPENTER: 'Mental Physiology.'

2. 'A lady in the last stage of chronic disease was carried from London to a house in the country; there her infant daughter was taken to visit her, and after a short interview carried back to town. The lady died a few days after, and the daughter grew up without any recollection of her mother till she was of mature age.

At this time she happened to be taken into the room where her mother died, without knowing it to be so. She started on entering it, and when a friend who was with her asked the cause of her agitation, she replied, "I have a distinct impression of having been in this room before, and that a lady who lay in that corner, and seemed very ill, leaned over me and wept."'—ABERCROMBIE: 'Intellectual Powers.'

3. The following is related by Coleridge, and shows how impressions, not understood in the least by the patient, were still registered and brought forth under the influence of appropriate stimuli:

'In a Roman Catholic town in Germany, a young woman, who could neither read nor write, was seized with a fever, and was said by the priests to be possessed of a devil, because she was heard talking Latin, Greek, and Hebrew. Whole sheets of her ravings were written out, and found to consist of sentences intelligible in themselves, but having slight connection with each other. Of her Hebrew sayings only a few could be traced to the Bible, and most seemed to be in the Rabbinical dialect. All trick was out of the question—the woman was a simple creature; there was no doubt as to the fever. It was long before any explanation, save that of demoniacal possession, could be obtained. At last, the mystery was unveiled by a physician, who determined to trace back the girl's history, and who, after much trouble, discovered that at the age of nine she had been charitably taken by an old Protestant pastor. On further inquiry, it appeared to have been the old man's custom for years to walk up and down a passage of the house into which the kitchen opened, and to read to himself

with a loud voice out of his books. The books were ransacked, and among them were found several of the Greek and Latin Fathers, together with a collection of Rabbinical writings. In these works so many of the passages taken down at the young woman's bedside were identified, that there could be no reasonable doubt as to their source.'—'Biographia Literaria,' 1847.

The centre for sensory memory is so arranged that every impression, received through a lifetime, is registered in a definite position and order of sequence, from the first moment of a child's life to the day of his death, and all sensations, perceptions, and ideas, received at the same time, either form component parts of one impression or closely associated impressions.

Of course, the above only applies to the brain when in a normal state, as departure from it is evidence of disease, amongst which must be classed those cases of senile failure in registering impressions.

A very rough illustration of the above may be given as follows: Supposing the centre for sensory memory, when the child is born, be represented by one side of a room covered with blank paper, then as time goes on, and he grows older, the paper becomes gradually covered with small pictures, words, &c., exactly as he has received the impressions; and so the process goes on, an addition being made every time an impression is received.

This illustration is only intended to exemplify the above fact, and not meant to imply more than that there is a position and order in the registration of impressions, not that the centre for sensory memory is filled up like the paper from left to right, as there is no proof that such is the case. It is probable that

what occurs is similar to the processes which bring about other periodical physiological conditions which occur with regularity and order of sequence, and at certain definite times. Thus, it is easy to suppose that the portion of the centre for the sensory memory corresponding to the first part of the blank wall is only developed in babyhood, and that the remainder is in a more or less embryonic state, and becomes gradually developed, to be ready when required.

Such a view as the above is in perfect conformity with our own sensations; we do not confuse an intense impression received in the past with one acquired more recently. We have a definite idea of the past, and though we may not be able to remember the details, we readily recognise them when related by others, and rarely confuse impressions. It is also a fact of common note, that the recollection of an event, which took place in days gone by, is quite sufficient to recall a number of circumstances which happened about the same time, and which bear no relation whatever to the first remembered fact, except that they happened about the same time.

We are able to perceive impressions of the past without any relation to the intermediate links. It is within the realm of nearly everyone's experience, to try to recollect some conversation, name, or circumstance, and find that he is unable to remember anything about it, and often to deny that such had ever happened; but in the course of the conversation some word suffices to revive the past impression, and the whole is brought vividly before the mind.

This shows the strong contiguous association of impressions received about the same time, which can

hardly be otherwise explained, than by assuming that the anatomical seat of each, is the same portion of brain, or portions closely adjacent. Though the above facts show the probability of such an arrangement (and it is also in conformity with the other processes of the mind, as will be shown in the following chapters), they do not afford direct evidence that such is the case; but there is evidence, and evidence of the most positive character, and it is this: *under certain conditions the memory for a definite period of time is lost.*

Numerous cases are on record of a person receiving some great shock, and on recovery being found to have lost the memory, not only of the circumstance which gave rise to the shock, but also of a certain period of time directly preceding it, all the events and circumstances which happened during that time being forgotten, the last circumstance remembered, preceding the blank, often being some trivial incident.

The following are excellent illustrative cases:

1. The ensuing is taken from *Mind*, October, 1887, p. 636. It is especially important on account of its happening to, and being related by, such an eminent psychologist and accurate observer as Professor Bain. He gives the following account: '"On October 23 last I rode out on horseback. The horse stumbled and fell. A labourer in an adjoining field saw the fall; on running up, he found me overlaid by the horse, and dragged me out insensible. I was taken to the adjoining farmhouse, and was found to have sustained various injuries, the worst being a bad dislocation of the right shoulder. The insensibility continued upwards of three hours, during which time my shoulder was set without pain or knowledge. When conscious-

ness returned, the memory of what led to the accident was discovered to be completely obliterated. In fact, the loss of memory extended to a full hour previous, and it has not yet been recovered. In no other respect did the concussion leave any permanent injury to the mental faculties." Professor Bain was on a different road from that which he remembers he intended to take on his way home. He must have changed his mind, but of the change, as of all that followed upon it till the time of the accident, he has as little recollection as of the hours he lay unconscious.'

2. Then follows another interesting case of a man who was thrown from a dog-cart, and lost all remembrance of the accident and of the occurrences of the previous week, which had been of a very eventful character for him. For the details of this case, which are similar to those already given, I must refer the reader to the original.

3. The following is taken from Ribot's 'Diseases of Memory': 'A young woman, married to a man whom she loved passionately, was seized, during confinement, with prolonged syncope, at the end of which she lost all recollection of events that had occurred since her marriage, inclusive of that of the ceremony. She remembered very clearly the rest of her life up to that point. At first she pushed her husband and child from her in evident alarm. She has never recovered recollection of this period of her life, nor of any of the impressions received during that time. Her parents and friends have convinced her that she is married and has a son; and she would sooner believe that she had lost a year of her life than that all her friends and relations are impostors.'

4. The following is related by Abercrombie in his 'Intellectual Powers': 'A young lady who was present at a catastrophe in Scotland, in which many people lost their lives by the fall of the gallery of a church, escaped without any injury, but with complete loss of the recollection of any of the circumstances; and this extended not only to the accident, but to everything that had occurred to her for a certain time before going to church.'

5. A young lady, having ascended an iron staircase, became giddy and fell down, being afterwards found insensible at the bottom. After her recovery, she had no recollection of the cause of her illness or the place where she had fallen down. Five years afterwards, she happened to go to the same place again, and immediately the whole flashed into her mind; she remembered becoming giddy and falling.

For further examples of this class of cases, see Chapter XII., on the 'Pathological Conditions of Memory,' where references will be given to numerous cases. The recording cells have become damaged in some way, probably in many, if not in all cases, by the intensity of the impression giving rise to the shock, and its intensity has caused it to destroy not only the recording cells in use at the moment, but also those which have just been used. Now, in these cases, the faculties are not interfered with, and if the view be taken that the perception and memory occupy the same position, and are a part function of certain faculties, we should expect that impressions belonging to the faculties in use at the time of the shock would be destroyed, and not impressions belonging to other faculties.

It is impossible to conceive how this loss of memory

could occur, if the view stated above be not the explanation. With regard to the theory, that the remembrance occupies the same portion of the brain as the perception, many of the perceptions, received ten minutes before, vary very considerably from those received just at the time of the shock; for within an hour, nearly every faculty of the mind is used, so that if the ordinary hypothesis be accepted, an explanation is required as to why impressions by other faculties than those employed at the time of the shock are interfered with, and why the faculties in action are not particularly affected. Further proofs, showing the impossibility of the remembrance occupying the same portion of the brain as the perception, will be given when treating of the functions of the faculties of the mind.

In the same way, it is impossible to explain the loss of memory in these cases, by supposing that there is disease of the sight, tactile, word, and other centres: to assume that this could be the case, and no other effect found than a loss of memory for a certain period of time without any other perversion of function, would be absurd. If this were the case, why should certain impressions be picked out, as it were? and why should all these be found to be those received in a definite period of time, and no others?

CHAPTER IV

MOTOR MEMORY

MOTOR memory is the memory required for the performance of co-ordinated muscular movements which have to be learnt: these include all those movements which require for their first performance (at least) an exercise of the will. This distinguishes these movements from those which are simply reflex, though the mechanism for the execution of the latter may be exceedingly complex, as in coughing. A reflex action requires for its performance, a sensory nerve, a nerve centre, a motor nerve, and a muscle. Then, an impulse having been generated, by stimulation of the sensory nerve, is reflected at the nerve centre, and passing along the motor nerve causes a contraction of the muscle. But, this reflex action may be inconvenient to the individual, and, therefore, require suppressing, as in cases of recovery from paraplegia caused by a tumour pressing on the spinal cord: the reflex actions are found to be excessive, and continue so, even after the removal of the tumour: the contact of the sole with the ground causes an excessive reflex contraction of the calf-muscles: after a varying time this passes off, as the higher nerve centres regain control of the lower. It will be seen that if we start with a certain reflex action, brought about by a particular sensory impression, by modifica-

tion, suppression, or combination of this movement, a variety of actions may be brought about. The controlling influence of the will may be seen by the effect of pricking a person engaged in deep thought (and so not paying attention to external impressions): the reflex action produced, is excessive, whereas, if he were talking, and actively alive to external impressions, he might restrain any tendency to action excited by the prick.

I will first outline the process employed in the acquisition of all movements, and separate the sensory memory, required for the performance of movements, from the motor memory which establishes them.

When an individual wishes to execute some definite movement, he forms an idea of how he is to do it. This idea is based on his sensory remembrance of other movements, and how they were performed, and a comparison is made between what appears to be necessary now, and his previous knowledge, all consisting of sensory memory impressions. He then tries to execute the movement according to this idea, and does so with more or less accuracy. Now, there is a sensory impression of *this* movement, which is remembered in the same way as other sensory impressions, and by means of which he is able to form a more correct idea as to how he should perform the required action. This is repeated several times, a sensory impression being obtained each time, until, at length, he is able to perform the movement with the required accuracy. The next improvement is in the rapidity of its execution, and less and less attention has to be paid to its performance.

Each time a voluntary action is performed, an impulse is discharged by the will to the muscles. This

impulse, being defined by the above process, is sent downwards to a portion of the brain, which represents all the muscles of the body (the centres of motor memory); thus, if in these lower centres, there are groups of ganglion cells, corresponding to the various muscles of the body, and governing them, an impulse to these cells will be sufficient to bring about the movement. The mind being concerned with the execution of the movement, and not with the individual muscles, the further elaboration of the impulse is brought about by the ganglion cells of the motor memory centres.

Each time the higher faculties send impulses to several of these governing cells at once, an association is formed between them, resulting in a permanent modification of their constituent protoplasm. By repetition of the same movement, this association of the cells becomes stronger and stronger, until a very slight stimulus is required to bring about the movement.

It is this modification of their protoplasm and association of the cells which constitutes the motor memory. The motor memory thus bears the same relation to the outgoing impulses of the mind as the sensory memory does to the ingoing impressions. The motor memory has, therefore, only to do with voluntary movements, or movements which have been primarily voluntary, but have become secondarily reflex.

It is by means of the motor memory that we are able to walk, ride, and skate, with ease, and if it were not for *it*, we should have the movement cease directly the attention was suspended, or temporarily transferred to some other object. Occasionally, the motor memory is found inconvenient, on account of its having become

so firmly established in an erroneous direction as to require every effort of the will to overcome it, and establish a new action. Every teacher of dancing, riding, or boxing, knows how difficult it is to break a pupil of any habit, he may have formed. A boxer, for instance, who has, for some considerable time, raised his right arm every time he strikes with the left, will find the greatest difficulty in striking with the left and keeping the right still. Examples might be given from all classes of co-ordinated actions, there being often more trouble in unlearning some erroneous movement than would have been required to learn the new one two or three times over.

To perfectly co-ordinate the muscles, necessary for the performance of any particular movement, usually requires a considerable amount of careful repetition.

Voluntary movements are naturally divided into two classes: those which do not require for their performance the preservation of the equilibrium, as writing, speaking, and drawing; and the more complicated class of cases, in which the maintenance of the equilibrium forms an important part of the movement to be performed, as walking, riding, and skating. The process can be especially well studied in the human being, as all movements, even of the simplest kind, are acquired more slowly than they are in animals.

It seems, that even the simplest co-ordinated movements are acquired, though when acquired very rapidly they have been said to be instinctive; though there is not the slightest reason to suppose that the process is in any way different in slow and quick

children, gradations can be found passing from one to the other.

A child, when born, is in possession of the higher faculties, and these have the same function then, as in after-life. Thus, the faculty of taste influences the mind with a desire to obtain food, but there is no sensory or motor memory at that time, they have to be acquired. The instinct to obtain food influences the child, and is stimulated by the condition of the body, and under these circumstances, the child, having no remembrance to guide it, first puts its hand into its mouth, and tries to obtain nourishment from it by suction. Sucking is a very simple movement, and one which, the sense of taste being in the tongue and palate, consists in getting those parts as close as possible to the object desired.

In the following illustrations, when the remembrance of a movement is spoken of, the sensory memory is meant, unless the word 'motor' be used. From what has been already said, it will be seen that it is from the *sensory memory* that the higher faculties obtain the knowledge necessary to enable them to establish the motor memory, for the mind has no cognizance of the motor memory, or what it is capable of performing, otherwise than by the sensory memory; the motor memory is only concerned with outgoing impulses from the mind, all ingoing impulses are derived from the sensory memory. This will be again referred to, and proofs given that such is the case. The act of sucking can be resolved still further, the sensory memory being introduced. Through sensory impressions an idea is formed by the baby as to whereabouts in the body the tongue is; these impressions are retained in the seat of

the sensory memory, and form the first rudiments of its acquired knowledge. Then, wishing to have something to taste, it tries to bring its hand into contact with its tongue, and makes some irregular movements of its arms in an endeavour to accomplish this result. At last, it does so, and the contact and the movement which brought it about, give rise to a sensory impression, and so a centre of localization is formed by the tongue.

The child soon gets to know, in a rough way, whether it is touching a part of the body near to, or remote from, the mouth, and so, after a varying number of attempts, remembers the movement necessary to bring its hand into its mouth.

In the same way, the movement of sucking is learnt; the child puts its hand into its mouth, and learns, by the remembrance of failures and successful attempts, how to get hold of the hand most firmly, namely, by the movements employed in sucking.

Having found that sucking its hand is unsatisfactory, it will suck some other object, applied to its lips, as the nipple or the teat of a bottle. The successful result of sucking these objects is remembered, in connection with them, and so, when next it feels hungry, the memory of this successful attempt occurs to it, and much less difficulty is found.

The effect of the primary desire in the production of the movement of sucking is practically appreciated by nurses. When a child will not suck, they put a little honey or sugar on the nipple, or let a little of the milk exude, and then let the child taste it. It will, at first, probably lick this off, but, on getting hungry later on, will remember this impression, and soon learn to

suck. But, in some cases, and especially when the child is feeble and weak, the intensity of the sensory impressions is so feeble that they are not recollected, and so it cannot be made to suck. An intelligent child soon knows where it has to obtain its food from, and when hungry tries to get at the breast.

I have described the above, to show how movements are acquired, but motor memory has had comparatively little to do with the processes, and so, before proceeding further, I will distinguish between the sensory memory derived from the muscles and the true motor memory. Sensory impressions, from the muscles and the limbs, inform a person as to the degree of contraction of the muscles, and the parts of the skin which are touching one another; from these he is enabled to judge of the condition of the limbs at any particular moment.

Therefore, if it were not for the sensory memory definite motor memories could not be formed. The distinction between the completed form of the sensory and motor memories for the purpose of writing, and the completed sensory but deficient motor form, may be seen, by making a comparison between the writing of the right and left hands of a person who has not been accustomed to use his left hand for this purpose. In analysing the writing of the left hand, we know that he has learnt how to write, and knows how to form the words, etc.—in fact, the sensory part of the memory is complete; but for all that, the writing is very poor, even when he pays the greatest attention to its execution, because there is no definite motor memory.

Let us take another example, in a child, of a more

advanced movement, such as is required in taking an object off the table and putting it in the mouth.

The child, at first, does not understand the use of its hand, but will probably try to seize the object with its elbow, but finding this a failure, puts out its hand, and after some trouble, being guided by sensory impressions, succeeds in reaching and taking the required object; so the child has its first impressions of distance, that is, the amount of muscular force and the space which the hand is made to pass through. If we take the tongue as the centre of location, as before, a rough estimation is accordingly made of the distance between the tongue and the object to be seized.

It is exactly the same with all other movements; the individual judges by remembrance of the various impressions, received at the time of the performance of the muscular movements, and by the aid of these he is able to co-ordinate his muscles, and a complete motor memory is gradually established.

When an individual tries to perform an action and fails, he sees by surrounding circumstances that he has failed; thus, in trying to reach a book, if he does not reach far enough, he at once sees his error. When a man tries to lift a weight and fails to do so, he still further exerts himself, and, succeeding, remembers the requisite amount of force to be put forth when exerting himself a second time.

The formation of an erroneous idea as to the weight of an object, and the amount of force accordingly used, is well seen in cases in which a man has been given an object, which looks light, but is really very heavy, to hold; he will be almost certain to let it drop.

Whenever a person wishes to imitate, write, or, in fact, bring about any movement, he has his senses to guide him, and to inform him as to the accuracy of its execution; thus, the musician is able to judge by the sounds produced, whether he be fingering the violin correctly. When the motor memory becomes established, less and less attention has to be paid to the process, and other work may be performed by the mind.

In the process of learning to write, the child commences with simple strokes: he forms an idea as to how these strokes should be made, and so a movement is brought about: the child is able to see, by comparison with the copy, whether the movement have been correctly performed or not, and so is able to modify it at a succeeding attempt. Each discharge of nerve force leaves a definite imprint, and resulting memory in the motor memory centre, and so, with each repetition, less and less nerve force is necessary to bring about the required movements, the motor memory becoming firmly established. In the same way, letters and words are written and associated, the motor memory centre retaining permanently those modifications of the protoplasm, which have been brought about by the voluntary impulses, which were discharged in order to accomplish the required movement. When a motor memory of great intensity has been formed, and the individual has some ideas which he wishes to express in words, he thinks of some appropriate sentence to express the idea, and the motor memory, in association with the sensory, having retained how each word should be written, brings about the required movements.

We now pass on to the second class of cases: those

in which the maintenance of the equilibrium forms an important part of the required movement, as walking, dancing, skating, or riding.

Man, on account of his erect position, requires this kind of co-ordination of movement more than any other member of the animal kingdom; even for the movements required in walking, a little consideration will show how important a correct estimation of the condition of the equilibrium is for the establishment of the requisite motor memory. It will be seen, that when the equilibrium has to be taken into account there is an additional factor involved, differing entirely from the sensory and motor memories, and consisting of something superadded. Those actions, in which the preservation of the equilibrium forms a part, are far more likely to become disordered than those which have not this factor, or only in a slight degree, as in swimming. A person who has once learnt to swim, very rarely, if ever, forgets the necessary movements; but the dancer, gymnast, and acrobat, get out of practice, as it is called, often to a considerable extent, and find, as they grow older, increasing difficulty in performing these sets of movements.

The difference, between this and the first class of cases is, that when a movement is required, for instance, that of pointing the toe forwards, besides the action which is intended to be performed, there are the movements which are necessary to prevent the body from falling.

These movements are brought about as follows: there is a centre which is in communication with the muscles, and with a special mechanism, by means of which, the mind is informed as to the condition of the

equilibrium, and by means of this information, the person is able to co-ordinate the right ganglion cells, and so bring about the correct movements. When there is a certain persistent repetition of the same movements, as in walking, a motor memory of great intensity becomes established, and the information afforded by the centre for the estimation of the equilibrium becomes less and less needed, the repetition of movement following on the succession of sensory impulses.

In those cases, in which there is a continual change in the position of the body, a strong motor memory cannot be formed for all the movements without an excessive amount of repetition, and even then, attention must be paid to the action which is being performed, when the changes in the position of the body do not follow in a definite order of sequence. These movements rarely become performed involuntarily.

It will thus be seen that for the rapid and easy performance of any co-ordinated muscular movement, in which the equilibrium is not required to be maintained, it is necessary:

1. That there should be an accurate sensory memory of former muscular movements.

2. That the mind should be able to perceive this memory, and act accordingly, associating the right cells.

3. That a stable motor memory should be formed.

And, in those cases in which the equilibrium has to be maintained:

4. That a stable motor memory be formed for those movements necessary to retain the equilibrium.

So, if any one of these processes be performed

imperfectly, there will be a corresponding imperfection in the execution of the movement.

Examples of the first condition being deficient are found in those persons who cannot remember how a movement should be performed; of the second condition being deficient, when a person remembers what he should do, but is unable to do it; many persons are able to write down an accurate description of the way to perform a movement, but are quite unable to execute it themselves. Nervousness often temporarily produces this condition; if the person were alone, he feels that he would be able to do what is required readily enough.

The third condition, or motor memory, is deficient, when much repetition is required to facilitate the execution of a movement.

Examples of the fourth condition being defective are found in those persons who are unable to dance, ride, or skate, becoming giddy at once on attempting a movement belonging to the second class, but finding no difficulty with those of the first.

The following case, related by Carpenter, shows that the motor memory may remember what has apparently disappeared from the conscious memory. A 'planchette,' made in Bath, which had been on a visit in various families for several months, having been asked where it was made, replied, 'Bath,' although the questioners all thought it came from London, and disbelieved its statement, which was afterwards verified. It is as well to mention that the 'planchette' acts through the involuntary muscular movements of the persons using it, and the above is easily explained in the following way: that though it had often replied

'Bath' before, the fact had been entirely forgotten as far as the conscious sensory memory was concerned, but was remembered by the motor memory; the slight impressions received, by putting the hands on the 'planchette,' and the questions asked, were sufficient to bring about the movement in the manner described in Chapter VIII.

CHAPTER V

THE FACULTIES OF THE MIND

Multiplicity of the Faculties of the Mind

IT is useless to enter into a discussion as to whether the brain is the organ of the mind or not, because I think that there are very few, if any, psychologists of the present time who would attempt to contravene that opinion. But, granted that the brain is the seat of the mind, there is still this point to be discussed, whether the brain be a single or a multiple organ. I shall endeavour to prove that the brain is a multiple organ. Before doing so, I wish to make a few remarks about phrenology. The arguments against phrenology, as expounded by Gall, are incontestible.

The following facts prove, even if the faculties were underneath the portion of skull marked out for them, the impossibility of ascertaining that such was the case.

1. The varying thickness of the skull in different persons.

The thickness of the skull varies very considerably. Anyone, casually comparing the skulls in the museum of the Royal College of Surgeons, can hardly fail to be struck by this fact; and not only this: many skulls are to be found showing very unequal thickness, being thick in one part and like tissue-paper in another.

This would greatly interfere with the possibility of ascertaining, by external manipulation, any slight deviation in the size of the brain beneath.

2. The presence of the frontal sinuses.

These vary very considerably without giving any external evidence of that variation. In the museum of the Royal College of Surgeons, there is a special collection showing the want of uniformity in the development of these sinuses. Such a condition must manifestly interfere with any estimation of the size of the brain beneath this portion of the skull.

3. Variations in the shape of the head, due to accident or disease.

I have almost invariably found, on interrogating a man presenting any striking peculiarities in the shape of his skull, that it has been due to a fall or disease, as rickets, hydrocephalus, or periostitis.

4. That a very large portion of the brain cannot be reached in any way.

Phrenologists have propounded a complete system, without taking into account those portions of brain lying at the base of the skull and the internal convolutions, which are of considerable size.

5. No account can be taken of an increased number of convolutions.

Supposing that the size of each faculty be due to the amount of grey matter in the convolution, then an additional convolution will greatly increase the amount of grey matter, but will not alter the shape of the skull situated above this portion of the brain. This is important, as, from observations which have been made, it is found that the brain is more convoluted in persons of superior intelligence.

6. The external surface of the skull-cap does not, in many cases, correspond to the internal plate.

It is very rare indeed to find a skull-cap which has the internal and external surfaces exactly corresponding, so this would interfere with a correct estimation of the brain beneath.

7. That, even granting that in many cases a correspondence can be found between the external conformation of the head and the character of the individual, there are many exceptions.

With the object of finding out whether there was any truth in phrenology, I made a point of studying it, and whenever I noticed any particularly well-marked trait in the character of a man, I looked for the corresponding phrenological 'organ.' As might be expected, I was often disappointed, especially with the organ of Concentrativeness (which I do not believe to exist at all as a definite faculty): I have several times found a hollow in the situation of this 'organ,' when great power of mental concentration has been one of the leading characteristics of the person examined.

In the same way, I have found a very great deficiency of the 'organ of Tune' in a musician, who, to judge from the character of his performances, ought to have had it largely developed.

So it is with the other 'organs'; though, in the majority of cases, they are found (the probable reason for this will be mentioned presently), there are numerous exceptions; so, simply examining the system on its own principles, it is found inaccurate.

8. The two sides of the head often show a considerable difference in size at corresponding points.

If the circumference of the head be taken, in the

same way as the circumference of the thorax is taken by the cyrtometer, it will, in a large number of cases, be found that the two sides of the head by no means necessarily correspond; thus, there may be a prominence on one side, and a depression at the corresponding point on the other side.

This asymmetry is well shown by an instrument of French construction, used for taking the exact shape of the head; it consists of a number of levers, fitting round the head like a hat, and terminating in sharp points, so that an exact impression of the head can be taken on paper. I have examined a number of these impressions, and was surprised to find how common asymmetry of the head is.

Now, it is perfectly certain that no correct estimation of a man's character could be formed (even if phrenology were true) if an 'organ' were found to be very large on one side of his head, and very small on the other. But, there is a *certain* amount of truth in the fact *that a certain shaped head is found accompanying a definite character*. That this can correspond, except in the very roughest way, to the conformation of the brain, is, from the above facts, shown to be absurd; and then all the faculties are *used up* (as a character can be told with a very fair degree of accuracy, only using the phrenological faculties), and none left for the remaining portions of the brain.

The explanation seems to be this: If we notice a large number of men, we shall see that, with a certain type of individual, we have a certain type of body, face, head, and limbs. A narrow head is inconsistent with a firm, massive face. A tall, thin man with long fingers and a narrow face, and a flattened, wide head would be

an anomaly. A little examination will show that certain shaped heads accompany similarly shaped bodies and hands. Artists have always recognised this, and would never make the mistake of putting an oval head on a round face. But the different parts of the body are in harmony, not only in a general way, but in minute particulars. Anyone wishing to comprehend how perfectly the shape of the head, face, and body correspond, should make a series of drawings from the life, and then cut the head from the face, and try to adapt the separated portions, putting the face of one person on to the head of another; the resulting combinations will look idiotic. So it is fallacious to think of localising any faculty of the mind by external observation. But the phrenologists have done some good: they have shown that the faculties are multiple, and, by observing a large number of individuals with exceptional endowments, have been able to form a fair idea of a large number of ultimate faculties.

The following are the proofs that the faculties of the mind are multiple:

1. Undoubted cases of hereditary genius, the child showing a predilection for a certain pursuit before education or any external influence could have had any effect. Thus, persons like Mozart, who have been undoubted geniuses, have in many cases given signs of their power at the earliest age.

2. The great difference in character and inclinations shown by children who have been under exactly similar external conditions; as in the case of the children of one family who have been all taught by their mother, and in the case of twins who have for all practical purposes been under exactly the same modifying circumstances,

however much they resemble each other in appearance, there is usually considerable dissimilarity in their talents and dispositions.

3. The original bent of the individual will often conquer the most adverse circumstances, in a way that a mere wish would never do. In an average individual, habit overcomes a wish, and the man simply *regrets* not having done so-and-so, but makes no effort to do it in the future. Additional evidence is found in the fact that a man will remain quiet and contented in an unsuitable position if he find an opportunity of employing the faculty in question, either as a recreation, or as a modification in his manner of conducting his business. Many of our greatest inventors have first taken up the subject of their discoveries as an amusement, ultimately abandoning an uncongenial occupation for the favourite pursuit.

4. We cannot substitute one faculty for another, as the function of each is separate and distinct.

5. The faculties are able to act alone, or simultaneously; the faculties act singly, when the attention is concentrated upon an object, which supplies stimuli for only one faculty, as, for instance, when a person is studying the hue of a colour, or trying to estimate the pitch of a musical note; when watching an exciting scene in a theatre, nearly every faculty of the mind is employed.

6. Genius is in most cases partial. The individual whilst showing great aptitude for one subject is unable to master the rudiments of another; as in the case of George Combe, who, though he studied mathematics for seven years, could never master the multiplication table. Here is an example, and numbers might be given, of

the almost entire absence of one faculty occurring in a very able man.

7. That the brain is made up of a number of ultimate faculties is the simplest plan to adopt. All the physiological processes could be explained by adopting this plan, but not by the hypothesis of a single organ; the difference in function is so great that we should as soon think of the liver taking on the function of the stomach, as the portion of brain devoted to the sentiment of love perceiving a tune.

8. The following seems to me a convincing proof of the multiplicity of the faculties. By careful observation of cases of excess or deficiency of particular aptitudes and desires, ultimate faculties can be defined. When this has been correctly done, we find that the faculty invariably has the same function, whether large or small, only differing in degree; that those conditions, which are met with as a consequence of the possession of the faculty in a large degree, will always be found in any other man possessing the faculty in the same degree, and be more or less absent in a man possessing a deficiency of the faculty. Thus, for example, take the faculty of locality, which has the function of perceiving relative positions, so that a man may know the relative positions of objects, and the position his own body has in relation to surrounding objects. A test for this faculty is, can the man find his way through a wood or town which he does not know, and then come back to the starting-point?

I have invariably found that the following are the effects of possessing a large faculty of locality. The possessor will not be easily lost, even in a strange place. He will like travelling for the sake of travelling. He

will remember well the relations of things, as the parts of a scene, the position of a word on a page; will learn geography easily, etc. (See 'Faculty of Locality.') A man with a deficiency of the faculty finds difficulty in all these points.

It will be found that if the influence of a faculty be increased by exercise of one of its apparent functions, it will be increased in all respects, thus proving that a special track cannot become developed. Thus, a person who has improved his faculty of locality by finding his way by it, will find that its power has not only improved in this respect, but also that he will be able to learn the positions of words on a page with greater ease, though he has not exercised this function of the faculty at all, the explanation being that it is the impressions in the sensory memory which alter, not the function of the faculty.

9. *Experiment.*—Ferrier's experiments on animals, and the demonstration of the motor centres, show the localization of a certain part of the brain, namely, at the sides, whilst the anterior and posterior portions are inexcitable. Therefore, what has been found true of one portion of the brain, is not likely to be found untrue of the remainder.

10. *Development.*—We find that faculties are not developed at the same rate at different periods of life. Thus, the majority of boys are disinclined to have girls for playmates, but after puberty their respect for the opposite sex is very much increased, and they have very different feelings concerning them. The pursuits of boyhood are thrown aside with advancing years. The reasoning faculties go on developing when the perceptives are declining.

11. *Congenital Deficiency.*—Idiots, though deficient in most of their faculties, occasionally show a remarkable aptitude for some particular pursuit, and this propensity can be explained by the possession of one of their faculties in an abnormally large degree. Its function, in this case, will be found to be exactly the same as in a healthy individual. Thus, there are some idiots who show a great talent for drawing or music; others who can remember with ease a number of unconnected words, or perform difficult arithmetical calculations.

12. *Insanity.*—In the insane it is rare to find all the faculties equally disordered, and it is very common for a single faculty to be especially affected, as in many varieties of monomania.

13. *Comparative Psychology.*—Anyone who has had anything to do with dogs or other animals, must have perceived that each one has a character of its own. Thus, we meet with the clever or stupid dog, in the same way as we meet with the clever or stupid man. There are good-natured dogs and ill-natured dogs; there are affectionate dogs and unsocial dogs. The same remarks apply to horses, cows, sheep, and other animals. (See Chapter IX.)

Many other minor facts and arguments might be adduced, but the above appear to me sufficient to convincingly prove that the mind is made up of a number of separate and distinct faculties.

Functions of the Faculties of the Mind.

Those psychologists who have admitted that the faculties of the mind are multiple, have decided that the memory is one of the highest intellectual functions,

the phrenologists marking out certain portions of the anterior lobe of the cerebrum as the seat of memory. Those physiologists who believe that the faculties consist of the sight, tactile, word, and other centres, are of opinion that the memory of impressions, received by these centres, has its seat in the same portion of the brain. Both, therefore, agree that the memory of an impression occupies the same portion of brain as the perception. This hypothesis is inconsistent with the view that the seat of memory is entirely below the plane of consciousness (the impressions stored up there only being brought before the mind under certain definite conditions); therefore, if it can be shown that the perception and memory do not occupy the same portion of the brain, even for a single faculty, the additional evidence in support of the view of the sub-intellectual character of memory is very great.

The following facts are strongly against the hypothesis that the perception and memory of any impression occupy the same portion of the brain.

1. They are totally distinct functions: memory is concerned with the whole impression, perception with the parts of an impression. The cerebral hemispheres and the external senses have similar relations to the basal ganglia. There is no evidence to support the theory that the cerebral hemispheres are the seat of memory.

2. The view, that the memory of an impression occupies a part of the brain distinct from the perception, is simpler and more consistent than superadding the function of memory to that of some of the faculties. Thus, why should the instinct to acquire and its special memory occupy different portions of the brain, whilst

the perception of a form and its memory occupy the same portion?

3. Through the constant association of a good memory for forms with a good perception of form, it has been prematurely concluded that they must occupy the same portion of the brain. Then the special memories of the remainder of the faculties are left unexplained, for a little observation will show that they exist as definitely as the memory for forms and words.

4. The association of the perceptions and memory, and the development of special memories, can be explained with perfect uniformity by adopting the view that the perception and memory are distinct.

5. The difficulty in comprehending how an impression could be subdivided, so that each faculty might take its share of the impression: thus, if the faculty of tune were the seat of memory for tune, the faculty of colour the seat of memory for colour, the faculty of causality the seat of memory for reasons, the faculty of comparison the seat of memory for comparisons, etc.

I will take for illustration the faculty of colour, as being the *very simplest* possible; but by no stress of imagination can I conceive how an impression of colour can exist apart from the impression itself, to be of any definite use in remembrance. Thus, how can the colour of an orange be thought of, as anything separate and distinct (more than a colour), apart from its form and size? The letters of an alphabet, printed in the same colour, only differ from each other in form, and without the latter cannot exist. How should the colour again become associated with its necessary form? There are only a certain number of colours, so that if the form were taken away from a picture, what would

there be to remember it by? How would it differ from other pictures in which the same colours were used? The locality of the colour would not help us, as this is said to be remembered by another faculty, the subject of the picture by another—in fact, a portion of nearly every faculty is used in remembering one simple impression; but how this is accomplished, or how the parts of the impression become again reassociated, I am at a loss to comprehend. What an appalling waste of tissue there would be, of the brain of a man looking along a crowded street, if the faculty of Form had to remember all the forms of the people, Colour all the colours, Eventuality the movements of the cabs, etc. Are these all separate impressions; and if so, how do the component parts become joined together again? But, I shall endeavour to show that repetition, as such, without conscious revival of the previous impression, does not intensify the impression; and unless we notice, with intent to remember, the objects around us, we shall very likely not remember them. What would be the process here in the above system? How is a form remembered? Do particular cells remember particular shapes, or does the faculty, as a whole, remember them?

The above questions seem to me unanswerable. But to go farther with this doctrine. How will the faculty of comparison remember comparisons? Here there is a combination of impressions belonging to the other faculties. Thus, if a man say to a friend, respecting the efforts of two performers, 'That piece was not sung as well as the previous one,' what impression is there for the faculty of comparison to remember? If we take away the words, tune, expression, etc., as belonging

to other faculties, there is nothing left to compare. Whereas, if the whole impression be remembered by the faculty of comparison, then the impressions of tune, &c., are useless. How are these impressions going to be arranged in the 'organ of Comparison'? I am afraid, with its multifarious duties, it would become too crowded for the purposes of comparison. Whereas, if the function of the faculty of comparison be that of influencing the mind of an individual to compare impressions, the whole can be explained in a comprehensible manner.

6. If the perception and the memory occupied the same portion of brain, we should naturally expect that when any faculty was stimulated, and its perception accordingly increased, its memory would be increased in the same ratio. Thus, that when the faculty of tune was being used, multifarious tunes would come rushing into the mind. In fact, it seems impossible to comprehend that a faculty can be exerted to the utmost in paying the whole of the attention to one tune, at *one* time, and that at another (as when a musician is composing) should be employed in 'perceiving into itself,' as it would have to, to remember appropriate chords and tunes which had been composed before, thus abrogating one function at one time, without any apparent reason, and taking it on at another. Such a theory is at variance with all the principles of physiology.

7. Destruction of a considerable portion of the anterior lobe of the brain, in many cases produces only a slight change in the mental organisation, whereas there would be a very considerable change if the greater part of the memory were destroyed. Should we not, if

this were the case, expect a break in the associations of the impressions, and that a person would remember the colour of the orange without its form?

8. Such a theory offers no explanation of the association of impressions which takes place when they are received at the same period of time. This is a process which plays a very important part in the physiology of the mind, in fact, this contiguous association of impressions, *without repetition*, is the most important function of memory; thus, the factors of the impressions representing a conversation, consist of the memory of a number of articulate sounds, connected by contiguous association; an impression of a picture consists of certain forms which are contiguously associated with each other, and certain definite colours. Without this contiguous association, forms, tunes, colours, &c., could not differ except within very definite limits.

Those cases which have been related of the loss of memory of impressions received within a certain period of time, have not been accompanied by a loss of function of any of the faculties. It seems improbable that one function of a faculty should be interfered with, and the other left untouched. Several psychologists have accounted for these cases by the hypothesis that an impression requires a period of time after its reception for its permanent fixation. This might explain those cases in which the period of time was short, but would hardly apply to those cases in which the loss of memory is one of months or years. Besides, though the patient may even, after recovery from the accident, have no recollection of how it came about, he may, as in a case which has come under my own notice, have the whole flash into his mind when visiting the site of the accident

some years afterwards, thus showing that the impression had been retained, and the recording cells not entirely destroyed. (See Case 5, p. 22.)

9. The above facts are sufficient to show that the theory that the memory occupies the same portion of brain as the perception, is not tenable, and to avoid prolixity and the introduction of processes which have not been already discussed, I have rested satisfied with the above, and hope that the incompatibility will be evident to the reader in perusing the following pages.

The mind is made up of a number of faculties, each of which responds to certain impressions, and influences the mind as a whole to seek after those impressions, and to avoid their negatives. The faculties of any particular individual may be compared with a certain definite, average standard, and according as each is above or below this standard (*cæteris paribus*) will he possess the capacity of appreciating the impressions which are peculiar to that faculty. For instance, a person possessing the emotional faculties larger than the intellectual will be emotional in character, each particular faculty influencing the mind according to its relative size. An individual, with the acquiring faculties very large, will have the impulse to acquire entering largely into the constitution of his mind, and so influencing his conduct and habits. In the same way, an individual with the intellectual faculties predominating will indulge in intellectual pursuits, and these will be in conformity with the faculty which is most above the average size, thus creating the scientific explorer, the artist, or the musician. When a faculty is stimulated by impressions peculiar to itself, it, for the time being, has its influence over the mind increased, thus temporarily having the

same influence as a larger faculty would have when not stimulated. This predominating influence is probably due to the arterial blood supply, of the portion of the brain which is the seat of the faculty in question, being temporarily increased. The great art of the orator and preacher consists in appealing to the faculties of his hearers so as to excite this temporary predominance. Barristers soon get to know those arguments which appeal specially to the presiding judge.

In making a comparison between the size of the faculties in different persons, there is a very important factor which has to be taken into consideration, and that is, the capacity which the faculties of any particular individual have of emitting nervous force. Nervous force is a product of the cerebral cells, in the same way that bile is a product of the liver cells. Nervous force is used up abundantly in all the conscious and voluntary processes of the mind, but very little, if at all, in those processes which are involuntary. The nervous force varies very considerably in individuals, and at different times in the same individual. Consciousness depends upon the nervous force, and when this gets below the minimum necessary for consciousness, sleep occurs. Where nerve force is predominant, there consciousness is at its height, and the ability for mental and physical exertion is very great. Where nervous force is at a low ebb, either temporarily or permanently, there is a corresponding disinclination for either. What a difference there is between the sprightly, intelligent person in whom nerve force is predominant, and the sleepy, lymphatic individual in whom it is deficient! The nervous force of particular faculties is used up in processes which are individually peculiar

to them, and which will be discussed in the next chapter. Most students must have noticed that it is a relief, when they are becoming mentally tired, to change the subject, that is, to use other faculties than those which have been previously employed. Thus, a man who may be falling asleep over classics may have his attention aroused by changing to mathematics. In a person of average ability, if any of the faculties be not used for a lengthened period, a great desire to exercise them is experienced. A great desire for physical exercise is felt after severe mental labour, and I have noticed that this physical exercise must be of a kind to employ the mental portion of the motor apparatus; thus half an hour's boxing or rowing is more efficient for this purpose than several hours' walking, which often has the effect of tiring the body without renovating the brain. Probably, many cases of sleeplessness are due to the unused faculties supplying an amount of nervous force which is inconsistent with sleep, or the vaso-motor apparatus which regulates the supply of blood to individual faculties has become paralyzed for those faculties, and so there is an undiminished supply of blood to the exhausted brain. The essence of the benefit which accrues to an over-worked mental labourer, on taking a holiday, is due to the change of employment, the abused faculties being allowed to rest, whilst those which were previously unused, are employed with vigour in combination with healthy out-door exercise. We are often surprised at seeing an over-cautious person act in the most reckless manner, and that at a time when he appeared to be more cautious than usual. Here the faculty of cautiousness has become exhausted, and its influence on the mind

temporarily abrogated, the person acting as if he did not possess the faculty. A student will often find that after he has gone through a lesson more than the usual number of times, which he knows by experience he requires to master it, he is unable to recollect a word; but after a period of time, as a night's rest, he finds that he knows it perfectly. This is due to the nervous force of the faculties employed becoming exhausted, in the process of perceiving the impressions, and they are accordingly not able to give out the requisite amount to revive the impressions, but do so readily the next morning. This is borne out by the fact that it is more likely to take place if the sleep be sound than if it be broken.

A faculty can be increased by exercise; but its function never alters; all artificial associations take place below the plane of consciousness.

The mind has cognizance of the impressions in the sensory memory, through the intellectual faculties, each faculty conveying its portion of the impression to the mind, and the intensity of the memory of an impression is in accordance with the intensity of its perception. Much light is thrown on the processes of the mind, and the relation which they bear to memory, by examining the process by means of which an orator composes a speech, or a musician an opera. An orator is anxious to make his discourse as interesting as possible, in order to obtain the attention of his audience. 'Interesting' is only a relative term. This is well exemplified by the great variety of pursuits and habits. A subject is interesting to any particular person according to whether it stimulates his largest or several of his faculties: the clergyman likes religious music, the

warrior prefers martial, which only differ in that they appeal to different faculties. An orator, preparing a speech, has first to think of the general outline of the subject he intends to speak about. He then thinks of appropriate illustrations, and revives previous impressions, to accept or reject, according to whether they appear suitable or not. The whole is retained in the sensory memory. When he wishes to speak, the ideas present in his mind, with the aid of the perceptive centre for articulate sounds, will revive appropriate words from the sensory memory.

The perceptive faculties are very similar, insomuch as each has to discriminate between adjacent members of a series. As I have shown in the chapter on Sensory Memory, we are conscious of the external world, not as it really exists, but as our *senses and faculties inform us of its existence*, and any interference, in the conduction of an impression from the senses to the mind, produces as complete a modification of the impression, as if the object observed possessed the quality expressed by the difference between the impressions. Therefore, if there be any deficiency in the perception of an impression by the mind, exactly the same result will be produced as if the perceptive elements in the sense organ were defective. Thus, all impressions of sight may be divided into three sets, those of form, those of size, and those of colour; the ultimate elements of each set may be ranged in a series, each member of this psycho-physical series being separated from the adjacent members by an interval which, if diminished, would cause a person with a large faculty for perceiving this class of impressions to say that the adjacent members were similar.

Let us first take the simplest possible example of this discriminating power of the faculties, that of the faculty of size. The psycho-physical size series may be represented by a number of objects of similar form, ranging from an infinitesimal speck to the size of the largest known object, the difference between each member of the series being a certain known and unvarying quantity, as defined above.

A man is shown two objects, situated at the same distance from his eyes, both square wooden blocks, but one being two and a half inches square, the other three inches, and is easily able to distinguish between them. Then, two fresh blocks are taken, the difference in size between them being less than that of the previous two, and on his distinguishing between these two, two more are taken, and so on, until he says two exactly similar blocks are being shown him. The point where this occurs will vary in individuals, according to the development and activity of the faculty possessed by each. An average can be obtained by examining a large number of persons; those who are very much below the average are size-blind. A similar result may be obtained by examining a number of persons with regard to pitch, a first-rate musician being able to distinguish a performer playing a false note, in a large band. If memory be introduced into the process of discrimination, the difference between individuals is still more clearly indicated. Thus, a certain sized block may be taken, and the person experimented on be required to say when he sees a block corresponding in size to the one previously shown. This corresponds to striking a note on the piano, and then telling the listener to say when the same note is struck again. In

these latter cases, the individual has to compare the impression in his memory with the impressions arising as each cube is shown him or note struck. A person with a large faculty of size would be able to correctly recognise that the present impression and the past were similar; and the two become associated; he knows that the name applying to one impression applies to the other. The function of the faculty of tune will be seen in perceiving and recollecting a long opera. I have previously shown how impossible it is to conceive, as anything definite, the colour of an object without its form and contiguous associations; in the same way, we do not perceive music apart from other components, as, for instance, the peculiarities of the various instruments and the musical notation. When an opera is performed, the music gives rise to impressions which are received in the sensory memory, the pitch impressions being especially intensified. Other impressions are revived and consciously associated with the present ones, giving rise to various ideas. When the musician wishes to recollect this opera, he first revives some special memory impression of pitch, and the remaining components occur to his mind. So accurately and vividly was Mozart able to recollect impressions, that he could compose without the aid of a musical instrument. He was able to bear in mind the peculiarities of the various instruments, and to arrange his composition in accordance with them, thus showing the impossibility of the whole being remembered by a single faculty of tune, there being numbers of impressions which are only artificially associated with music, as the written notes, and in fact, the musical instruments themselves.

Having shown that the perception and memory of an impression are perfectly distinct functions, it now remains to consider the relations those functions bear to one another. I have already said that a coloured photograph would fairly well represent an impression of sight. I will, therefore, take for example a photograph as representing the impression of a person seeing it. First, with regard to the forms in the photograph; a form series may be constructed, the factors of which vary from a straight line to the greatest possible curve, and by a combination of these factors all known forms can be represented, corresponding to the colour series made up of the colours of the spectrum, or the pitch series made up of notes differing in the number of vibrations per second. The faculty of form perceives the impressions of form, not as separate disjointed members, but as a form which consists of these members, contiguously united. The intensity of the resulting memory depends upon the intensity of the perception of these individual members, and it is in direct relation to it—when the perception is weak the resulting memory is weak, and *vice versâ*. When a faculty is large its possessor is able to perceive impressions which belong to it with great ease, but the chief power which a large faculty gives its possessor, is that of discriminating between adjacent members of a series; thus, with the form series, persons vary, from those who have an ability to perceive the most minute resemblances, to those who are only able to discriminate between a straight line and a semicircle. It is a very common occurrence, for two persons to be looking over a photographic album, and one to say, 'Those two men are brothers, are they not?' and for the other to reply,

'Yes; but how could you tell? There's not the slightest resemblance between them.' But the original speaker declares that he sees a striking likeness. The reason of this is, that the man who fails to perceive the likeness, has a psycho-physical form series, the units of which are far less numerous than those of his friend, and so he is not able to perceive a difference less than that between two of the units.

This may be made plainer with a simple illustration. Let six figures be drawn on paper, four being perfect circles, but the other two differing from circles in having one diameter slightly shorter than the other. Now, the above person would say that these were six exactly similar figures, the difference between the units of form making up the figures being less than that between the units of his psycho-physical form series. His friend would recognise the 'likeness' between two of the circles. The countenance varies very considerably in different persons, but the above shows how a person, with a deficient faculty of form, is often at a loss for a means of identification; therefore, as the distance between the adjacent psycho-physical units increases, so does the means of recognition diminish. Failure in recognising an acquaintance, consists in the fact that the person is not able to recognise the present impression as being identical with the past.

Colour-blindness is an affection due to deficiency of the faculty of colour. Variations are found from those who possess the most acute perception for colour, to those who are completely colour-blind. The larger the faculty, the more a person possesses the power of discriminating between adjacent members of the colour

series. When it is small, the person confuses all the colours on the right hand side of the spectrum and all the colours on the left-hand side, but not those on the right side with those on the left. Thus, a want of power to perceive differences of colour brings about colour-blindness. It will be seen that if the retina and all the parts below the mind performed their functions properly, there would still be colour-blindness, if the power to perceive colour were deficient. Observers do not take sufficient account of mental deficiencies of perception when reasoning upon the functions of the senses. Thus, we cannot say for certain that a photograph represents the image on the retina; in reality, it *may* be far more complicated. It must be remembered, that the impression of the photograph has to pass through the same channel (the eye, optic tract, and brain) before it reaches the mind: thus, if there were no faculty to perceive colour, we should have no knowledge of colour as it exists, however plainly it was represented on the retina. The same applies to the pitch, size, form, or any other psycho-physical series.

There are, therefore, three faculties which perceive impressions of sight: form, size, and colour. It can be easily proved that all impressions of sight are made up of the members of the series belonging to each. As has been already shown, it is the contiguous association of these various members which produces such an endless variety of impressions. Thus, a person possessing the three faculties above-mentioned, of at least average size, will see all three factors in an equal degree; if either of the faculties be larger than the others, then the factor perceived by that faculty will predominate over those perceived by the other faculties. If either

be deficient, then the person will be form-blind, size-blind, or colour-blind, as the case may be, in a corresponding degree; the difficulty in perceiving and discriminating between the individual constituents producing this result. A picture may, therefore, be inaccurate in one or more of these respects, and a person with a large faculty of form, but a small faculty of size, would detect minute errors of form, but overlook very great errors in perspective and other points depending upon size. Besides the power which the intellectual faculties possess of discriminating between the members of the various psycho-physical series, they are also able to discriminate between varying degrees of physical intensity of the same unit. This physical intensity of an impression must not be confounded with the psychical intensity of a perception from which it is quite distinct. Thus, the same note on a piano may be struck softly or with more force; the impression would be more intense in the latter case, but a person might pay great attention to the sound of the note when struck lightly, and take no notice of the loud note; the intensity of the perception of the latter would, therefore, be much less. The intensity of an impression depends upon the number of superimposed similar units, the unit of intensity being the feeblest impression capable of giving rise to a sensation.

The functions of the faculties will, therefore, be seen to be very similar, and consist in responding to certain stimuli and conveying certain ideas to the mind. The intellectual faculties differ from the remainder, insomuch as each has to convey certain impressions from the sensory memory to the mind; they agree, however, in this, that for each faculty and for each

individual, a psycho-physical series can be constructed, and, according to the units of this series, ideas of resemblance or dissimilarity between impressions will be obtained. But each unit of a psycho-physical series may have different degrees of intensity, depending upon the physical intensity of the impression, so that a number of similar psycho-physical series could be constructed; thus, our taste series might have the bitter represented by one unit of quinine in an ounce of water, and the sweet by one unit of sugar, the second series containing two units of each, and so on, each series increasing by a unit. Each faculty has, therefore, the function of perceiving between these different degrees of intensity.

We have now to consider the special action of the faculties on the sensory and motor memories, respectively.

Action of the Faculties on Sensory Memory.

We find, as an invariable rule, that when an individual is the possessor of an abnormally large faculty, he has also a correspondingly powerful memory in connection with it. This memory is made up of impressions or parts of impressions, which it is the function of the faculty in question to specially perceive.

The resulting intensity of the memory of an impression is in exact relation to the vividness with which it is perceived, that is, with the amount of consciousness (or mental activity of the individual at the time of reception), and the relative size of the faculty.

A feeble impression can be revived (remembered) if

sufficient nervous force be given out, and this will be the case with a large faculty.

These two conditions, alone, would be sufficient to develop a special memory in connection with each of the faculties; but then that particular faculty being specially predominant in the mind, the individual has a bias in that direction, and seeks to employ it, both in looking out for means of satisfying it, and by continually revolving the same in his mind.

There is every reason, therefore, why a special memory should be developed; for the individual seeks objects which interest him, notices them particularly, and is continually thinking about them. I will give an example in illustration of this.

A good musician has a large faculty for the perception of tune. This has a corresponding influence on his mind, and he seeks amusements and occupations which are congenial to him. So, in the first instance, he is in a position to acquire impressions of tune. Then he perceives impressions of tune in a far better manner than a less gifted person, from the greater attention that he pays to them, and also from the special power of his faculty of tune. Also, as the musical faculty predominates in his mind, he is composing or considering music (that is, reviving previous impressions), whilst other people are either thinking of nothing in particular, or of other matters.

Let us consider the proposition that the larger the faculty, the more easily is a feeble impression revived. This is easily demonstrated by letting two perfectly uneducated persons, one of whom has a large faculty of tune and the other has not, listen to an air played to them, both listening attentively. The one with the

musical faculty will remember, and whistle it after having heard it once, whilst the other may hear it a dozen times, and still not repeat it correctly.

I have said uneducated individuals, in the above example, so that the cultivation produced by a musical education might be perfectly excluded.

Occasionally, we meet with an uneducated country lad who can whistle with a correctness that would do credit to a good musician.

Therefore, the development of a special memory is due to a large faculty, causing:

1. The primary intense perception of its impressions.
2. The seeking for those impressions.
3. The revival of previous impressions, and the consideration of them.
4. A large amount of nervous force to be given off, so that even feeble impressions are revived.

It is the same with all the faculties. A cautious, timid individual perceives danger in everything. He is always revolving plans for his personal safety in his mind. He is always the first to take alarm, and remembers anything remotely connected with danger.

So it is with a money-making, grasping man: he thinks of money; he is quick to see any scheme by means of which money may be made; he revolves plans for making money in his mind, and easily remembers anything in connection with money.

The influence which the faculties have in raising the intensity of any impression, plays an important part in recollection, and this will be discussed in a later chapter.

Action of the Faculties on Motor Memory.

There appears to be only one faculty which directly acts on the motor memory, and that is the faculty for muscular co-ordination. But it is influenced by the particular bias of the mind, and it is in this way a special memory is developed. Thus, a mechanic thinks over the best way to employ his tools, and uses them accordingly The muscles are co-ordinated in the necessary way, the nervous impulses, as they pass through the corpora striata, leaving a permanent memory in its cells.

Let us consider the motor memory of a violinist. The execution of the various movements to be employed in fingering the violin, and the regular connection with the various notes, which must be perfectly known, show a special motor memory of a very definite description. But it will be noticed that the movements, employed by different violinists, are not precisely the same; each has his own style and peculiarities, which are independent of the correct rendering of the music. It is the same with other classes of movements; individual peculiarities are evident on making a comparison between a number of persons. These peculiarities are due to the influence of predominant faculties; thus, a cautious person has a hesitating way of performing an action. Character can be told with a fair degree of accuracy by a person's handwriting or walk.

Therefore, the motor memory is influenced indirectly by the various faculties of the mind, and each of the resulting special memories consists of two portions:—

1. That portion which is essential to the correct performance of the movement, and which depends upon

certain definite faculties; thus, the motor memory required to correctly finger the violin, depends *primâ facie* upon the faculty of tune, and without it could not be developed.

2. The portion which is due to the influence of predominent faculties, and which, though not essential to the correct performance of the movement, gives individuality of style to the performer.

Special motor memories, in the acquirement of which the equilibrium has to be taken into consideration, are necessarily developed with much greater difficulty, as a much larger number of muscles have to be co-ordinated, namely, those necessary to preserve the equilibrium.

Having thus defined the functions of the faculties as a whole, I will now proceed to consider them in detail, first examining those of the phrenological system, which is certainly the best system extant, as far as the discovery and definition of ultimate faculties (excluding memory) is concerned. The following are the names of the faculties of the phrenological system; those to which letters are attached are still *sub judice*:

1. Amativeness.
A. Conjugality.
2. Parental Love.
3. Friendship.
4. Inhabitiveness.
5. Concentrativeness.
B. Vitativeness.
6. Combativeness.
7. Destructiveness.
8. Alimentiveness.
9. Acquisitiveness.
10. Secretiveness.
11. Cautiousness.
12. Approbativeness.
13 Self-esteem.
14. Firmness.
15. Conscientiousness.
16. Hope.
17. Spirituality.
18. Veneration.
19. Benevolence.
20. Constructiveness.
21. Ideality.
C. Sublimity.

22. Imitation.
23. Mirthfulness.
24. Individuality.
25. Form.
26. Size.
27. Weight.
28. Colour.
29. Order.
30. Calculation.
31. Locality.
32. Eventuality.
33. Time.
34. Tune.
35. Language.
36. Causality.
37. Comparison.
D. Human Nature.
E. Agreeableness.

In this system the following faculties are well defined: Amativeness, parental love, destructiveness, acquisitiveness, secretiveness, cautiousness, approbativeness, self-esteem, firmness, conscientiousness, hope, spirituality, veneration, benevolence, imitation, form, size, colour, calculation, locality, eventuality, time, tune, causality, comparison.

The above, abrogating the function of memory, may be regarded as ultimate faculties, and will be described as such.

Concentration of attention is a property possessed by all the faculties; anyone is capable of paying attention to the subjects in which he takes an interest.

With regard to conjugality; vitativeness, inhabitiveness, sublimity, individuality, order, human nature, agreeableness, and constructiveness:

I am inclined to think that not one of these is an ultimate faculty, but that they arise out of the occupation and habits of the individual, and are dependent upon the faculties already named. Thus, conjugality is not likely to influence a man who hates his wife. With regard to love of life, every faculty, in its normal state, would incline a man to care for life.

Inhabitiveness, or love of place, arises from many conditions, as associations, habits, etc.

Sublimity is a very doubtful faculty.

Individuality.—This is an unnecessary and reduplicate faculty; thus large form, colour, or desire for information of any kind, would incline the individual to observe.

Order seems to arise from common necessity, being a habit of the individual, and not a definite faculty; it is probably a development of locality and time.

Human nature and *agreeableness* would have to be very composite faculties. I have never seen an example of such faculties, and do not believe that they exist. Those who are accurate judges of human nature, are those who intend to be so, and carefully notice their fellow-creatures. When a man dislikes another, without apparent cause, and without being able to give a reason for doing so, he has probably had some disagreeable impression revived by the other's appearance, and the prejudice is as likely to be wrong as right.

Constructiveness is a composite faculty; its functions are such as would arise from necessity or desire, influencing the faculty of motor co-ordination.

With regard to the remainder of the list—combativeness, alimentiveness, ideality, mirthfulness, weight, language, friendship:

Combativeness.—This is a bad name for the faculty; courage is much better. Some of the most peaceable men are the most courageous. It is only when combined with destructiveness that a desire to fight is felt.

Alimentiveness.—See Taste.

Ideality.—This is a bad name, as it expresses more

than an ultimate faculty. Love of beauty is the probable ultimate faculty.

Mirthfulness.—This name does not correctly express the faculty; a sense of superiority, however produced, incites mirth, in entire absence of this faculty. Incongruity is a better term.

Weight.—This faculty partially corresponds to, and is included in, muscular perception.

Language.—This faculty is made to include spoken and written words, and even gestures. It is clear that there is a faculty for remembering words *as spoken*, but written words and gestures are remembered by form.

Friendship.—This is a bad name, for it does not express the function of the faculty; a person may have this faculty large without really caring for anyone but himself. It creates a desire for company, and a person possessing it large, will often make a companion of someone he dislikes, 'for the sake of company.' A better name is sociality.

Besides the above, there are faculties for the perception and recollection of odours, impressions of touch, temperature, and muscular perception, perseverance, and for motor co-ordination.

CLASSIFICATION OF THE FACULTIES OF THE MIND.

The faculties of the mind may be divided into—

A. THOSE DIRECTLY CONCERNED IN SENSORY PERCEPTION.

I. *Impressions derived by sight.*

1. Colour. 2. Form. 3. Size.

II. *Impressions derived by hearing.*

4. Articulate sounds (spoken language).
5. Tune.

III. *Impressions derived by smell.*

6. Odours.

IV. *Impressions derived by taste.*

7. Tastes.

V. *Impressions derived by the sensory cutaneous and sensory muscular nerves.*

8. Tactile Perception. 9. Temperature.
10. Muscular Perception.

B. Faculties of Composite Perception, Reason, and Imagination.

11. Locality. 15. Eventuality.
12. Time. 16. Comparison.
13. Number. 17. Incongruity.
14. Beauty. 18. Causality.

C. Faculties concerned in Motor Organisation.

19. Imitation.
20. Motor Co-ordination.

D. Faculties of the Propensities and Emotions.

a. Selfish.

21. Acquisitiveness. 25. Cautiousness.
22. Perseverance. 26. Secretiveness.
23. Destructiveness. 27. Approbativeness.
24. Courage. 28. Firmness.
29. Self-esteem.

b. Social.

30. Amativeness. 31. Parental Love.
32. Sociality.

c. Moral.

33. Love of Truth. 35. Spirituality.
34. Hope. 36. Veneration.
37. Benevolence.

CHAPTER VI

THE SPECIAL MEMORIES

Functions of the Individual Faculties.

The functions of each particular faculty will now be discussed, but it is important to note that in the following descriptions many well-known names of faculties, as acquisitiveness, self-esteem, &c., are used for the sake of convenience, the terms fairly well expressing their functions; but beyond the definitions given in the following pages, no other function must be assumed to belong to them, as in many books, written and spoken language are included under the same faculty, which a very little experience is sufficient to show is practically, as well as theoretically, wrong. Again, the memory of any impression has been shown to be distinct from the perception, though intimately connected with it, and many other minor differences will be noticed under the separate faculties. The definitions given here are in accordance with my own experience of the functions of the faculties, and I hope will be found sufficiently accurate for all practical purposes. When any faculty is subsequently referred to, its functions will be understood to mean those given here, and this will be of importance to anyone wishing to ascertain the constitution of his own mind, so as to be able to use his

faculties in the most advantageous way, in the cultivation of his memory.

In the majority of instances, readers will find that they have all the faculties in an average degree, variations rarely being *very* great, either above or below the average. Occasionally, exceptions are to be found in which some faculty is either particularly large, or particularly small, and to these the exceptional examples apply. A student should try to form as accurate an idea as he can as to the size of the faculties he possesses. In order to facilitate the attainment of this object I will first give the functions of each faculty, and then the special memory which is developed by its possession, giving for examples persons who have been gifted, by having a large development of the faculty in question. When a large faculty is spoken of, in the following pages, it is not meant that this should be taken literally, but only in relation to its function.

1. *Faculty of Colour.*

The designation of this faculty explains its function, namely, that of conveying to the mind, from the general memory, impressions of colour, that is, contiguous combinations of psycho-physical colour units. When largely developed, the individual takes the greatest interest in colours, and can easily remember minute differences between them. It is the faculty of the painter, as distinguished from the draughtsman. The spectrum, as usually observed, forms an admirable illustration of a psycho-physical series, six colours being clearly distinguished, each colour blending by imperceptible gradations with the adjacent members of the series. The psycho-physical does not correspond to the physical

series, as there is no break in the latter, which consists of rays gradually increasing in refrangibility from the red to the violet. The average psycho-physical series has only six units, the mind perceiving all rays within a certain range of refrangibility as red, those beyond this range as orange, and so on. The physical light series is also of greater length than that represented by the spectrum, there being rays, both below the red, and above the violet. If the spectrum be looked at through a piece of cobalt glass, a bright crimson will be seen below the red, whilst the presence of rays above the violet is demonstrated by fluorescence and other phenomena.

Each of the colours of the spectrum is primary, and cannot be again split up; thus, if after white light has been dispersed by a prism, another prism be inserted in the track of the first, so that only one colour shall be refracted at a time, it will be found that the individual character of each will be preserved. Again, a pure blue when mixed with a pure yellow does not give green as a resultant. If a spectral blue be mixed with a spectral yellow, the resultant will be white. If red and yellow are mixed together, an orange is obtained which is indistinguishable from the orange of the spectrum. Now, the orange of the spectrum is produced by rays of light having wave-lengths quite different from those of the red or yellow, therefore, the perception of similarity must be mental. The cause of the phenomenon is this: the psycho-physical colour series consists of six units (six is the average number, there being more units if the faculty of colour be large, less if it be small), and, therefore, all colours are perceived by any particular individual as combinations of

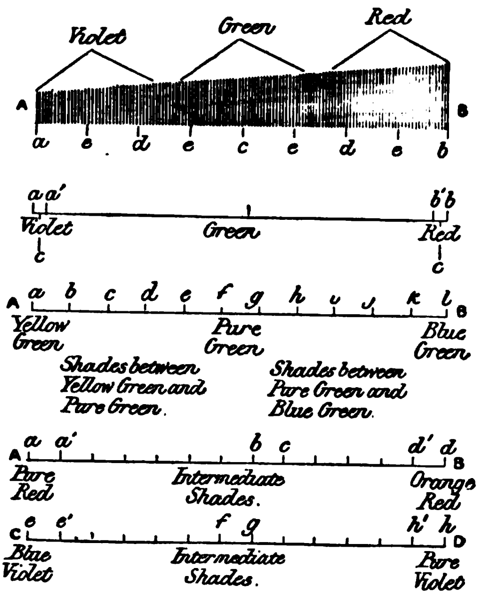
these colour units. Colours may also be modified by a greater or lesser admixture of white light. The physical intensity of a colour depends upon the number of rays, of a similar character, which are received on the retina at the same time. When a mixture of red and yellow is brought before the mind as a sensory impression,

FIG I.

FIG II.

FIG III.

FIG. IV.



previous impressions of red and yellow are revived, and as it is perceived that it is neither one nor the other, but midway between the two, and the mind having no cognizance of any colour other than orange between red and yellow, it is called orange, and on future occasions, orange is revived and brought before the mind by a mixture of red and yellow. This will be made clearer

when the laws of remembrance have been discussed, and exactly corresponds to the results of the experiments with the pseudoscope on the human face, in which we have positive proof that the mind does not necessarily perceive the impression on the retina, as received. When two colours possessing very different wave-lengths, as red and blue, are mixed together, a new colour is formed, 'purple,' which differs from the prismatic colours in being more readily perceived as a mixture. All the phenomena of colour may be explained by psycho-physical perception, the rays situated on the border lines between the psycho-physical colour units being especially liable to be perceived differently, according as the contiguous colours vary.

Figure 1 shows the physical light series, the length of the waves being indicated by the length of the lines. *a* and *b* indicate the two points of greatest difference, namely, those at the ends of the series: *c* indicates the third point of difference, *d* the fourth, *e* the fifth. It will be seen that whilst there are several fourth and fifth points of difference, there is only one each of the first, second, and third points. In a psycho-physical series there is only one of each, and they appear first on one side and then on the other. Figure 2 shows two absolute psycho-physical units, one in the red and one in the violet, *aa′* and *bb′*: as all the rays included between *aa′* and *bb′* appear absolutely alike, any one ray, as that at *c*, might be substituted. Figure 3 shows the absolute psycho-physical units in the approximate psycho-physical unit green. Figure 4 shows the absolute psycho-physical units in the approximate units red and violet.

The above diagram illustrates colour perception, and may also be used in order to explain perception by any other faculty, the impressions perceived by that faculty being substituted for those of colour.

The respective vibrations for the rays at the ends of the spectrum are as follows: 395 billions of vibrations per second for the extreme red, and 763 billions of vibrations per second for the extreme violet. Here we have an enormous physical series, extending wave by wave, from the red to the violet. What an example of the finite character of the human mind we have here! There are billions upon billions of colours, and yet we are only able to see six, or at most seven. We are not even cognizant of the limits of the physical series. We know that there are heat rays and actinic rays, because we have direct evidence of their existence, but we do not know where the light series commences or terminates: there may be rays considerably below the red or above the violet, which are performing useful work, and which can never be brought under the direct evidence of the senses. It is even possible that the greater part of the work of the world is performed by these rays. All physical series have no commencement, termination, or definite unit, whilst a psycho-physical series—that is, a physical series as perceived by the mind—has a definite commencement, termination, and unit which differs with individuals.

Let us consider the evolution of the colour sense from the standpoint, that all perception is the perception of difference; we can suppose that, at first, the spectrum appeared monochromatic, and all external objects as represented in a photograph. When the colour sense was first developed, the two farthest apart rays of

the spectrum appeared coloured, that is to say, a tinge of colour appeared at the ends of the spectrum, and grey between. As the colour sense improved, it was not necessary that the rays should be so far apart before a difference was seen, and so the grey band gradually diminished, until it entirely disappeared and the two colours met in the centre of the spectrum. Then a third colour would be seen in the centre, then four colours would be seen, then five, and then six, the normal number.

We will now consider the subject under the following heads.

I. *The Physical Series of Colour.*—It is evident that before we can have a psycho-physical series, we must have a physical series; and this is admirably represented in the case of colour by the solar spectrum. This is the most perfect example of a physical series which can be obtained. By dispersion the sun's light is spread out in the form of a series, the wave-lengths of the units gradually diminishing from the red to the violet. The presence of gaps in the solar spectrum in the shape of Fraünhofer's lines shows that the series is not a perfect one. The presence of a very large number of Fraünhofer's lines shows that the spectrum is pure, and that the rays of light do not overlap.

The points of greatest difference may be obtained by measurement of the wave-lengths. It is evident that the two points of greatest difference do not come within the visual range at all, because the waves in the infra-red present a greater physical contrast to those in the ultra-violet than any two rays in the visible spectrum. If we take the portion of the physical series

represented by the spectrum, the two points of greatest physical difference are the first visible ray of red and the last visible ray of violet. The third point of greatest physical difference is the centre of the spectrum. The next two points are found between the third point of difference and the ends of the spectrum. These and subsequent points can be found with the aid of mathematical equations.

II. *The Psycho-physical Series of Colour.*—When a physical series has been obtained, the mental impression of this series constitutes a psycho-physical series. The appearance of the spectrum to any person, constitutes the psycho-physical colour series for that person. The question then is, What is the appearance of the spectrum to the majority of persons? Most persons say that they can see six definite colours in the spectrum—red, orange, yellow, green, blue, and violet; and that one colour appears to shade off into those adjacent to it. We can examine the spectrum in another way—that is, by only observing a small portion at a time, either using shutters to a spectroscope, or letting the spectrum pass through a slit which only allows a small portion to pass. When the spectrum is viewed in this way, it appears to be made up of a series of monochromatic bands. The size of these monochromatic bands differs with different persons; that is, a band which is monochromatic to one person is not necessarily monochromatic to another. These bands are absolutely monochromatic; that is, if a portion of green were taken, the observer could not say which was the yellow and which was the blue side of the portion of light shown. But we know that the portion of light, though

apparently monochromatic, contains rays of light which differ very considerably in wave-length, therefore, we have a number of physical units which cannot be distinguished from each other. These units are seen under the most favourable circumstances for the detection of any difference, the adjacent colours being excluded, and yet they appear alike. The first obvious inference to be drawn from this is, that the rays of light occupying a monochromatic band are identical for the observer as far as perception is concerned. In the psycho-physical colour series, therefore, the absolute psycho-physical colour units are portions of the spectrum which appear —when the remainder of the spectrum is shut off—monochromatic. Such, for example, are the several varieties of green which we can distinguish. As the band of colour appears monochromatic, we could substitute an equal number of any one of the rays of light entering into its formation, without altering its appearance as far as colour is concerned. From this it is evident, that nearly all the experiments, which have been made by physicists with regard to colour, will have to be looked at from a psycho-physical standpoint, as this is a source of error which appears to have been very generally overlooked. As we can only tell an absolute psycho-physical colour unit from the adjacent units by carefully comparing them, it is evident that the difference between them is not sufficient for practical purposes, so we come to the approximate psycho-physical colour units, that is to say, colours which can be easily distinguished from each other without comparison.

These approximate psycho-physical units, for a normal-sighted person, are six in number—red, orange, yellow, green, blue, and violet.

There are, therefore, six definite points of difference in the spectrum, to a normal-sighted observer, corresponding to the centre of each of the colours, red, orange, yellow, green, blue, and violet. As each of the colours at these points must, by the presence of the adjacent points, blend with each other, we have the approximate psycho-physical units formed. It will be seen, that if the size of the absolute psycho-physical units be increased, the size of the approximate units will also be increased. As the spectrum remains the same length, the increase in size of the approximate units results in their re-arrangement and diminution in number, and hence colour-blindness. In the first degree of colour-blindness, five instead of six distinct points are seen in the spectrum, in the next degree four, and so on, until total colour-blindness is reached.

Let us return to the theoretical aspect of colour. We have to find out the points of difference in a psycho-physical series of which the spectrum is the physical series. It is evident that if the perception of difference is very defective, the spectrum appears colourless and simply brighter or darker, according to the intensity of the light; a person of this kind is totally colour-blind, and the whole of his spectrum could be matched with varying proportions of white and black—that is, gray. If the perception of difference is not quite so defective as this, the extreme ends of the spectrum appear feebly coloured, and the remainder gray. The spectrum appears nearly all gray, but with a tinge of red at one end, and a tinge of violet at the other. It will be seen that, as perception improves, the tinge of red and tinge of violet will invade the gray and approach each other,

because the wave-lengths need not be so proportionately different before a difference is seen. It is obvious that all the colours of the normal-sighted which are included in the coloured portions of the spectrum are seen alike, and may be represented by that colour of the normal-sighted which corresponds to the centre of this coloured portion. It is obvious that no difference in colour is seen between the various portions of the coloured band, because if a person is not able to see any difference between yellow and blue, it is evident that he will not see any difference between red and orange. What are the two colours seen when the whole of the gray has disappeared? As I have shown, the colour will be represented by that which in the normal-sighted corresponds to the centre of each of the two visible colours. According to the theory, these centre points ought to correspond to the centre of the two halves of the physical colour series. The two colours should be complementary to each other. It is evident that these complementaries must be those which are closest to each other as far as the spectrum is concerned. The complementaries which are adjacent to each other are yellow and blue.

These colours are the yellow and blue, having the wave-lengths of 2,120 and 1,781 respectively, the ratio of the wave-lengths being 1·190. These two colours should meet in the green.

The next step will be the formation of another point of difference at the centre of the series; that is to say, there will be three definite points of difference instead of two. These three points of difference will be the centres of the terminal psycho-physical units and the centre of the spectrum; that is to say, the

three points will be the centres of the red, green, and violet of the spectrum.

It will be noticed, in a psycho-physical colour series, in which a person is able to see three colours, that the two points of greatest difference will be between the points of difference of a person who is only able to see two colours and the ends of the spectrum, because his approximate units are smaller. Taking, for convenience, the centre point of an approximate unit as representing that unit, it will be noticed that, as more colours are seen, these points are gradually moved towards the ends of the spectrum. In the normal-sighted, therefore, the two colours presenting the greatest contrast are the red and violet.

There are many persons, who, whilst admitting readily enough that the three points of greatest difference in the spectrum are the red, green, and violet, would object to red and violet being the two points of greatest difference. It is evident enough, in a series of discs, that the largest disc presents the greatest contrast to the smallest one; and, in the sound series, it is evident that the deepest bass notes form the greatest contrast to the highest treble, provided that both are heard distinctly.

There are several reasons why violet should not, at first sight, appear the colour most strongly contrasting with red. The most important reason is, that very few of the violets met with in nature are pure—that is, the object is found to reflect some of the red rays in addition. If we compare monochromatic strips of spectral colour, we shall see that true violet presents the greatest possible contrast to red. The difference is admirably illustrated by using

the terms warm and cold, which artists have applied to these colours.

The other reason for not regarding red and violet as the most dissimilar colours is, that violet is regarded by most persons as a mixture of red and blue. But red and blue do not make violet, as will be seen by mixing the pure spectral colours. Red and blue make a purple, which plainly shows the element of red. Violet is a colder colour than blue, and, instead of being a transition colour between blue and red, it is more unlike red than blue. Let the reader look at a spectral violet, and he will be unable to detect any red element whatever. This shows that colours must be looked at as forming a series, not a circle. As red and violet, and red and blue, can be combined, we have a double series, one consisting of the spectral colours, and the other consisting of hues of purple. Those who look at colour from a scientific standpoint regard the complementary of any colour as that which contrasts most strongly with it. It will be found, on referring to the chapter on the physiological phenomena of colour, that this is not the case.

Another point for consideration is: Shall we take the end members of the series as the points of comparison? If we cannot distinguish any difference between members of a series, as far as we are concerned, they may be considered to be exactly alike.

It is evident that there is an absolute psycho-physical unit at each end of the colour series represented by the spectrum. I have defined an absolute psycho-physical unit as a portion of a physical series, in which it is impossible to see any difference between the members of the series, even under the most favour-

able circumstances, and with the most careful comparison. Then, not only the end member of the series, but any one of the members, included in the absolute psycho-physical unit, might be taken to represent the unit, without in any way affecting the result. In addition to there being an absolute psycho-physical colour unit at each end of the spectrum, there is an approximate colour unit, and these are the colours red and violet. As an approximate colour unit consists of a portion of a physical series, the members included being not easily distinguished from each other, and so much alike as to be called by the same name, *cæteris paribus*, the central point of this unit will be that which is most representative of the colour. If any portion of the unit presented any marked difference in intensity, it is probable that the most intense portion would be selected.

Having shown how the psycho-physical colour series appears, with three approximate psycho-physical colour units, we must consider where the fourth point of difference would be situated.

If the units of a physical series differ from those adjacent to them in a proportional manner, the fourth and fifth points of difference will appear at the same time, and be situated at points midway between the centre and ends of the series. The units of the light series do not differ in a proportional manner, if we are to regard the wave theory of light as the correct one. Therefore, in the psycho-physical colour series, the fourth point of difference will appear before the fifth, and be situated at the point of greatest difference. The waves of light at the red end of the spectrum are larger than those at the violet end, and, therefore, the

fourth point of difference will appear at a point midway between the red and the centre of the green, namely, the yellow. An example with smaller numbers will show why the fourth point of difference should appear on the red side of the green. Let us suppose that we have a series of vibrating members, the vibrations being from 5 per second for the lowest member to 105 per second for the highest member. There will be much more difference between the first and second members of the series than between the last member, and the one just before it. In the first case, there will be a difference of $\frac{1}{5}$, in the second case $\frac{1}{104}$, a very much smaller fraction. The fifth point of difference will appear midway between the violet and the centre of the green. The sixth point of difference will appear on the red side of the fourth point of difference. There will then be two points of difference between the red and the centre of the green, namely, orange and yellow. It is evident, that when orange is seen, the fourth point of difference—namely, yellow—will appear to have moved towards the green, the fourth point of difference now being a combination of the two, namely orange-yellow. This can be seen to take place if a spectroscope be arranged so that no orange is seen. A spectrum of this kind can be obtained with a fine slit; on slightly widening the slit, so that more light is admitted, the orange will be seen, and the yellow will appear to change its position and move towards the green. The seventh point of difference will appear between the green and the violet; that is to say, there will be two points of difference, or colours seen, between the green and the violet, instead of one. It is not necessary to consider the extension of the series any

further, because I have not met with a person who could see more than seven colours in the spectrum. The series could be extended *ad infinitum*, the extra point of difference being put, first on the red side of the green, then on the violet side.

I have now discussed the theory of psycho-physical perception in its application to colour. I have shown what we should expect from this theory in its relation to colour-blindness. The question is: Are these predictions fulfilled? Yes; they are, in the minutest particular. Not only does this theory explain all the phenomena of colour-blindness in the most complete manner, but it accounts for a number of phenomena which were previously unexplainable.

It will be found that most persons see six colours in the spectrum, and that these colours appear at the points which I have predicted.

In some cases seven colours are seen, and then the seventh colour appears at the point where it should appear by theory. In the first degree of colour-blindness only five colours, or points of difference, are seen in the spectrum; in the next degree, four; in the next, three; then two. Then a neutral band appears at the blue-green junction, and this increases in size in different cases until total colour-blindness is reached. Therefore, the vision of the normal-sighted being hexachromic, the vision of the colour-blind is pentachromic, tetrachromic, trichromic, or dichromic. It will be noticed that the greatest difference is to be found between the three-unit and the two-unit cases of colour-blindness, the primary colours for each being quite different. The two primary colours for the two-unit are yellow and blue, and they each represent

half of the spectrum. In the case of the three-unit the three primary colours are red, green, and violet. Red combined with green forms yellow; violet combined with green forms blue; so it is evident that these colours occupy the positions which I theoretically allotted to them.

The following will give the normal-sighted reader the best idea of this theory of colour-perception and the various phenomena of colour-blindness. He knows that he can see six definite colours. Let him for the five-unit imagine that five of his adjacent colours are spread over the spectrum; for the four-unit, four; for the three-unit, three; for the two-unit, two; for the one-unit, one. Looking at the subject in this way, he will at once comprehend how it is that the colour-blind are able to recognise colours and correctly name them. As an example of this method of looking at the subject, let us represent the two-unit by the two adjacent units, blue and green. It is obvious that a normal-sighted person could distinguish different colours even if only two were visible to him. Then colours might be named in the following way. A dark but pure green would represent red; a very bright green, orange; the brightest possible green, yellow; a bright but not quite so pure green, yellow-green; a duller and not so pure green, pure green; a mixture of the two colours, blue-green; a blue with a trace of green, blue; the purest possible blue, violet. This is how a certain two-unit learned to distinguish between colours, and his friends had great difficulty in getting him to name them wrongly. Again, if we consider the three-unit as represented by the three colours, red, orange, and yellow, of the normal-sighted, we see how a mixture of red and violet gives

rise in the three-unit to a sensation very similar to green, as a mixture of red and yellow, with the normal-sighted, gives rise to a sensation very similar to orange.

Colour, as a quality of objects, is much less to the colour-blind than it is to the normal-sighted, and in direct proportion to the degree of colour-blindness. The colour-blind rarely make remarks about colour for this reason, and generally say that it interests them very little. In the three-unit, the three most distinct colours are red, green, and violet—that is to say, the centres of their three psycho-physical units. In the simple two-unit the colours which are best seen are yellow and blue, the centre colours of each of the units. This is a point which all simple two-unit colour-blinds agree about; they say that the yellow buttercup and the blue sky give them the strongest and most contrasted sensations of colour. The three-unit find that they have a large number of superfluous colours; their vision is trichromic, whilst that of the two-unit is dichromic. The apparently superfluous colours will be confused with those which they can see distinctly; this will be especially the case with purples, browns, and grays. Rose, made up of a mixture of red and violet, is a colour with which they find especial difficulty, and according to the proportions of red and violet will the colour be classified; thus, a purple containing less red than violet will be classed with the violets, whilst a rose-red containing more red than violet will be classed according to its shade with red, orange, or yellow. A rose which consists as nearly as possible of equal parts of red and violet will often be mistaken for green, in the same way as the normal-sighted fail to distinguish

an orange made up of red and yellow from a pure orange, reflecting the orange rays of the spectrum. The close relation which purple, green, and gray have to each other, even for the normal-sighted, is shown by the changeable silks of my Pocket Test.

With regard to the colours seen by each, the most typical colour will be that corresponding to the central point of each unit.

The number of approximate psycho-physical units seen by any individual in the spectrum, will be the number of colours he is able to see, and under no circumstances will he be able to see more than this number. We also know, that if any two colours belonging to adjacent units be mixed—for instance, blue and green—we obtain a mixture which is not a fresh colour, but one possessing the characteristics of both of its components—that is, a modified unit. Also, in many cases, if we mix the colours belonging to two units, not being adjacent ones, we shall obtain a colour corresponding to that lying between the two. From these facts we can deduce definite laws of colour perception which are applicable in all cases.

1. *An individual can have no conception of a colour which does not form one of his psycho-physical colour units, or a very apparent modification of one of those units.*

2. *If the colours belonging to two adjacent units be mixed, an impression of both units is obtained which is plainly perceived as a mixture.*

3. *If two colours, not being adjacent units, be mixed, the colour between the two will tend to be revived and brought before the mind, or white will be the result in the case of pure light, gray when there is partial absorption.*

4. *If any number of colours be mixed, the resulting impression will be that of a unit, a modified unit, or white.*

There are other alterations in a sensation, which have to be taken into consideration in individual cases, besides those described in detail above. I have mentioned the influence of the sense-organ in limiting a psycho-physical series, but the sense-organ may directly alter the apparent colour of a body through absorption; then, it will be relatively different from that of other persons. For instance, the crystalline lens has a tendency to become yellow with age: all objects, to a person of this kind, will appear less yellow than they would be to a person with a normal lens.

III. *The Effect of a Shortened Spectrum upon Psycho-Physical Colour-Perception.*—In the preceding pages I have considered the effect of a lessened perception of difference, the length of the psycho-physical series being the same in each case.

The effect which shortening of the psycho-physical colour series from any cause would have upon psycho-physical colour-perception, now remains for consideration.

The first obvious effect would be, that the portion of the series which was not perceived would, for that individual, be practically non-existent. Therefore, any colour consisting only of these rays would appear black, and these rays would have to be subtracted from the composition of any colour in which they formed a component part.

The junctions of the various colours would also be slightly different from that of the corresponding class

with a spectrum of normal length. It is obvious that the perceptive centre can only be cognizant of sensations which are conveyed to it, and sensations which are not conveyed to it are, for all purposes of perception, non-existent. For instance, let us consider the positions of the junctions of the units in a case of three-unit psycho-physical perception with shortening of the red end of the spectrum. This limited spectrum will have to be divided into three, and then it will be found, that both the red-green and the green-violet junctions are situated at points occupying positions nearer the violet end of the spectrum than the corresponding junctions of those with a spectrum of normal length. The red-green junction, therefore, in a case of this kind, will be situated in the yellow-green instead of in the yellow, as it is in three-unit cases with an unshortened spectrum.

A person with a faculty of colour below the average will have the number of his psycho-physical colour units correspondingly diminished, the number of light undulations which are perceived as one unit having greatly increased; thus, if orange has disappeared from the series, half of the light undulations which ordinarily give rise to a sensation of orange are perceived as red, and the other half as yellow. It is impossible to say that the image really is that which is depicted on the retina, because all impressions have to pass along the same track; thus, if total colour-blindness were universal in man, no correct idea could possibly be formed of the coloured image on a rabbit's retina, because *that* colour would be as much lost as any other. The following facts are in favour of the view that colour-blindness is due to a deficient development of this faculty.

1. That colour-blindness corresponds exactly to form-blindness, or tune-deafness, and the results of deficiency of any other faculty.

2. That we find that there are different degrees of colour perception, varying from the power to detect the most minute differences to complete failure in recognising any colour.

In the first degree of colour-blindness, five instead of six distinct points are seen in the spectrum, in the next degree four, and so on, until total colour-blindness is reached.

3. That we meet with cases of shortening of the ends of the spectrum, corresponding to those who are unable to hear very high or very low notes.

4. That the spectrum shows that a completely red-green-blind person only sees two colours in the spectrum, all the warm colours being confused with one another, and all the cold, but the warm never being confused with the cold. There are various stages from this degree of colour-blindness up to the average perception of colour.

5. That the colour perception of an individual with a large development of the faculty, is as superior to that of an average individual as his is over a colour-blind person.

6. Colour-blind persons rarely notice colours and take no interest in them ; thus, one man who possessed a large faculty of locality, and was therefore very fond of travelling and scenery, said that he never saw any colour in his recollections of the scenes. Now, if colour-blindness were only due to an absence of one set of retinal colour-perceiving elements, the other two sets being normal, a colour-blind person would take quite as much interest in the two elements that he had as

normally-constituted persons do in their three; but I have always found the above to be the case, and it exactly corresponds to want of perception of form, or pitch.

The spectrum is as follows:

1	2	3	4	5
Red.	Orange.	Yellow.	Green.	Blue.
		6		
		Violet.		

In partial cases the adjacent colours are confused with one another; in complete cases all colours are seen as a mixture of black and white.

This is analogous to the case of an individual who fails to perceive a striking likeness between two photographs, or to the girl who could not distinguish between the sound of the small bell and the sound of the large one.

Any one who wishes to pursue this subject further will find additional information in my book on Colour Blindness, Vol. LXXI. of this series. It is an extraordinary thing, but it seems almost impossible to get the Government of this country to recognise the importance of not employing blind and colour-blind men in positions in which the lives of their fellow-men depend upon their possessing accurate eyesight. Incredible as it may seem, it is nevertheless the fact, that, in spite of the numerous accidents which have occurred through colour-blindness and defects of sight, proper tests are not adopted. There is no law ensuring that engine-drivers and pilots are tested at all, and the Board of Trade have adopted tests for the Mercantile Marine which only give a false sense of security; as it will be

noticed in the last report of the Board of Trade that, of those who were rejected and appealed, the enormous percentage of $38\frac{2}{21}$ passed. A test that rejects over 38 per cent. wrongly, needs no comment from me. Those in authority cannot claim ignorance in the matter, as I have repeatedly pointed out to them the unsatisfactory nature of the tests they were employing and the necessity for having properly qualified examiners. The great objection to the wool test which they employ is that it does not detect the most dangerous class of colour-blind persons, namely, those who are not able to see a red light at all, as it is obvious that this will not prevent them from matching a light green wool with other green wools. I am convinced that a wool test alone can never be perfectly satisfactory; therefore, I would strongly urge that supplemental tests, including a definitely constructed lantern, should be used.

In order to give the reader an idea of the danger to which he is liable, I will mention, that when I was surgeon on board one of our largest passenger steamships, I removed a man who was nearly blind from acting as look-out! This man could not say whether one finger or five were held up before him!

If colour be large and form small, the individual will distinctly perceive minute differences of colour of various objects; but these objects will have no *individuality of form* as perceived mentally; so, though a straight line may be distinguished from a semicircle, two similar curves may be confused, the confusion being mental, and not due to any fault in the perceptive apparatus or received impression. For an example of the special memory of colour, as well as size and form, see page 97.

2. *Faculty of Form.*

This faculty conveys to the mind ideas concerning impressions of visible form, being only concerned with the forms and shapes of objects as represented in a photograph. Any form, however complicated, can be split up into units, each of which consists of a simple line. The physical series commences with a straight line, and terminates with the greatest possible curve. If these could be represented on paper, an artist, like Turner, with a large faculty of form, would say that several of the adjacent units were similar, and in this way a psycho-physical series could be constructed. By examining a large number of persons an average could be made.

This faculty gives its possessor a liking for drawing, and facility in perceiving resemblances between people. How the recollection of faces chiefly depends upon this faculty has been already discussed. Those who have it largely developed will remember an acquaintance whom they have only casually seen years before, whilst those in whom it is deficient will not recollect persons with whom they have been spending the previous evening, their psycho-physical form series being so limited. The physical intensity of a form impression depends upon the thickness of the line giving rise to the impression.

This faculty perceives all forms, and therefore includes written figures and written words, which, however, have the strongest contiguous association with ideas of number and the special memory impressions of spoken words respectively. The special memory developed by this faculty is well illustrated by those artists who are able to draw accurately from memory;

thus it is said of Turner that, having carefully looked at a ship, he was able to go home and draw from memory the details of the ship, as accurately as if he had been standing in front of it.

It is also well developed in many detectives and police-officers, who are able to recognise prisoners under the most adverse circumstances. It is said of Cuvier that he was able to recognise a similarity in form in the most extraordinary manner, never forgetting the shape of an object he had once seen.

Other examples are very numerous, but the most remarkable is the following, related to Abercrombie by Dr. Duncan, of Edinburgh, who heard it on the spot, and saw both pictures:

'In the Church of St. Peter, at Cologne, the altar-piece is a large and valuable picture by Rubens, representing the martyrdom of the Apostle. This picture having been carried away by the French in 1805, to the great regret of the inhabitants, a painter of that city undertook to make a copy of it from recollection, and succeeded in doing so in such a manner that the most delicate tints of the original are preserved with the most minute accuracy. The original painting has now been restored, but the copy is preserved along with it, and even when they are rigidly compared, it is scarcely possible to distinguish the one from the other.'

The above is an example of the memory of size and colour, as well as form.

The following example shows an extreme deficiency of this faculty in a professional man of exceptional ability, who has kindly allowed me to record it. He has taken the highest honours in his profession, but

fails most lamentably to remember names or forms. So great is his deficiency in remembering forms, that he is unable to recognise his best friends (until they speak). He has got into an omnibus and sat opposite his mother, and thought to himself that he seemed to know her face. He has met his brother or sister in the street, looked them straight in the face, and failed to recognise them. He says that he should not like to have to identify his wife in a court of law (if he had to judge of her by her features), and thinks it incredible how a witness can swear to another person. He has to judge in other ways, as by their speech, peculiarities, etc. But he is able to draw, and the sketches (which, of course, are not very complicated) are very fair representations of the object intended, and from which they are copied very carefully. But on a minute examination of the drawings, there was found to be no *individuality of form;* the curves and lines were the simplest possible, and looked as if they might have been executed with the aid of a ruler and compasses, which, in fact, many of them were. He has the same difficulty in remembering names, and finds the greatest trouble in recollecting them, until they become associated with a definite idea or fact. It is in this latter point that he particularly excels; he is able to remember facts with the greatest ease, provided he can put them into his own words. Thus, he will emember the substance of a paragraph easily, on once reading it through, though he has always found it impossible to learn by rote, however easy the text might be. He will look intently at a person whom he has failed, at first, to recognise (but has done so subsequently by other faculties), and will find that

his face is gradually becoming more and more familiar, until, at last, he wonders how it was he could not recognise his friend at first. This case forms a good illustration of the fact that revival of the whole impression takes place when a part is accurately recollected.

3. *Faculty of Size.*

This faculty has the function of perceiving the visible size of objects. Its function is manifestly different from that of the faculty of form; thus a sixpence and a half-crown are of the same form, but differ in size. Anyone with this faculty largely developed could say whether a certain figure was of the correct relative size to the rest of the objects in a picture, or whether a certain sized stick would fit in a known hole, or the correct proportions of a marble statue. The psycho-physical size series has been described under the functions of the faculties.

The special memory helps the individual to a correct idea of the relative adaptability of things. A lady with this faculty well developed, never made a mistake in choosing articles for the various rooms of her house, and was always found correct in her estimation of the size required.

The inability of most people to correctly estimate size may be seen, by asking half a dozen persons the height of a certain tree.

Touch aids us in the formation of ideas of *real* size, but less than would be, at first, supposed, because this faculty conveys to the mind ideas of distance (which is only size of space), as well as those of size, as seen in a photograph: by comparison with previous

impressions correct ideas of the size of objects are obtained.

4. *Faculty of Spoken Language.*

This faculty has the function of perceiving and conveying to the mind impressions concerning articulate sounds. It is quite distinct from that of pitch, and perceives those irregular sounds, which, added to the voice, make up speech. The vowels are modifications of a fundamental sound, produced by variations in the size of the oral opening and oral canal. Kempelen has compiled the following table:

Vowel.		Size of Oral Opening.	Size of Oral Canal.
a	as in 'far'	5	3
a	„ 'name'	4	2
e	„ 'them'	3	1
o	„ 'go'	2	4
oo	„ 'cool'	1	5

The consonants are additional sounds produced by the action of the moveable parts of the apparatus of articulation, past which the sound has to travel; hence the names, labials, linguals, and gutturals. But the number of elementary sounds in any language is considerably in excess of the named consonants, and the total number of possible sounds is not used in any language. The sounds perceived by this faculty can be arranged in a definite psycho-physical series for each individual. The estimation of a psycho-physical series for this faculty appears at first sight impossible, and so it would be, if there were a universal language, on account of the association of impressions. How this association is brought about will be described in the following chapter. Though, for all practical purposes,

this faculty is only concerned with articulate sounds, theoretically, it has to do with all those sounds which make up the physical series, in which the units of sound that, contiguously associated, constitute language, have a place. A person who has a large faculty of language is able to remember a large number of unconnected words belonging to languages with which he is not familiar, as in the case of the Indian, mentioned by Pepys, who was able to repeat, after hearing it once, a long passage in Greek or Hebrew, though he was ignorant of either language. If, say, ten or a dozen persons be taken, and a sentence from a language with which none of them are conversant be recited to them, on asking each to repeat the sentence, psycho-physical differences will be evident. There are many persons who are not able to repeat a foreign word (the meaning of which they do know) even after hearing it frequently. This faculty has the power of perceiving the psycho-physical units of which any sound is composed, and if the series be a large one, correct ideas are formed concerning any foreign word. The impressions in the sensory memory do not differ for individuals, except in intensity; it is in the perception which is conveyed to the mind concerning them that we meet with differences. This is well shown in those cases in which words, the use of which is not known to the speaker, have been uttered during a fever. Again, on account of the association of impressions, which occurs when a child is learning its native language, impressions are brought before the mind which would not have been otherwise perceived. A word is associated with the ideas which it represents, and this is a purely artificial association; *mère* and mother represent the same ideas;

but *mère* would convey no idea to the mind of a person not understanding French.

It is of especial importance to notice that the faculty of language has only to do with the perception of articulate *sounds*. It is only indirectly concerned with *written* language; there is no essential connection between the two, the whole process being an artificial association (see p. 164). Written language is remembered *as such* by the faculty of form. The form 'p' might with equal consistency stand for the sound 'tee' as for the sound 'pee,' as, in fact, it does in some shorthand systems. One author uses a slanting stroke for the letter 'p,' another a perpendicular stroke. But the connection between the two lies in their strong association, the two forming constituent parts of numbers of impressions. It then follows that if either be known, the other can be easily revived, because we know the sounds which correspond to certain forms (letters), and *vice versâ* (of course, not including such words as 'yacht'), and so a person knowing one can recollect either, at will.

A good practical illustration of this is the following: A gentleman found great difficulty in remembering the names of persons, but at last found a way to do so efficiently. He made a note of the name he wished to remember; he did not require to refer to the note, but never afterwards forgot the name. I must add that he had an exceptionally large faculty of form, being able to recognise old schoolfellows whom he had not seen for twenty years. This is an example of the substitution of one faculty for another; this gentleman remembered words from having seen them *written*, that is, he saw the form of the word so

clearly that it at once recalled the feeble part of the impression, 'the sound.'

The physical intensity of an articulate sound is its greater or less loudness, and this is readily distinguished from the psychical intensity of an impression in the sensory memory. A person will remember a word as easily (often better) if it be spoken in a moderate, as in a loud tone.

A man with this faculty largely developed can learn words by heart almost *ad libitum*, scarcely requiring to hear them more than once. He may not understand what he hears, but learns the explanation off by heart. In most cases his words exceed his ideas, so that he uses a large number of words to express a single idea, being a great talker without any benefit to his hearers. He is also able to learn foreign languages easily. The opposite is found in individuals who know what they want to say, but find a difficulty in remembering the requisite words; they use the smallest possible number of words to express their ideas. They find great difficulty in remembering the names of people, and cannot master a foreign language.

Shakespeare must have possessed an exceptional development of this faculty, to judge from the variety of words he uses in his plays.

Seneca says that he was able to repeat two thousand unconnected words after having heard them once, in the same order as they were given, simply by his natural powers of memory. He also mentions two other examples of an extraordinarily retentive memory for words: the first of a friend of his, Porteus Latio, who never forgot any of the speeches he had ever delivered, and never found his memory fail even for a single word.

The second is that of Cyneas, an ambassador to the Romans from King Pyrrhus, who learnt in a single day the names of the assembled people. This he did so well as to be able next day to salute the senate and the populace each by his own name. In this example there was an extraordinary memory for form as well, because it was necessary for him to be able to recollect the face of each as well as his name. Pliny says that Cyrus knew the name of every soldier in his army.

Abercrombie relates the following:

'Dr. Leyden, who was distinguished for his extraordinary power of learning languages, could repeat correctly a long "Act of Parliament," or any similar document, after having once read it. Being congratulated by a friend on his remarkable gift, he replied that, instead of being an advantage, it was often a source of great inconvenience to him. This he explained by saying that when he wished to recollect a particular point in anything which he had read, he could only do so by repeating to himself the whole from the commencement, till he had reached the point he wished to recall.'

Numerous other examples might be given, as illustrations of this class are very common, and are related in most of the books on memory, as if this were the only kind of memory possessed, 'memory' being synonymous with 'memory for words.' For an example of a great deficiency of this faculty, see Form.

5. *Faculty of Pitch* (Tune).

This faculty conveys to the mind impressions of the pitch of sounds, which form the basis of all music. Experimenters have obtained very different results with

regard to the limits of perception of sound; a scale varying from 8 to 36,500 vibrations per second is the one most generally accepted. The musical gamut consists of a series of seven notes, which succeed each other from the bass to the treble, the eighth note or octave being of a similar character to the first, and possessing double the number of vibrations per second. If a second series be constructed, taking the eighth note as the first, it will have a very similar character to the first series; and a melody, composed with the aid of the first series, preserves the same character when sung by the second series. The note which forms the first of the series is arbitrary, and, therefore, a large number of musical scales may be constructed, as long as the proper relation between the notes be preserved. The musical interval is the relationship which the number of vibrations of the notes bear to one another. The intervals between the notes are not equal. Thus, if Do $=1$, Re $=\frac{9}{8}$, Mi $=\frac{5}{4}$, Fa $=\frac{4}{3}$, Sol $=\frac{3}{2}$, La $=\frac{5}{3}$, Si $=\frac{15}{8}$, Do $=2$—that is, if Do be produced by 24 vibrations per second, Re will be produced by 27, and so on.

From this it will be seen, that before music can be appreciated for itself, a person must have a correct perception of the relations between the notes. By experiment, a psycho-physical series could be constructed for each individual; a person who is unable to distinguish a note in the treble from a note in the bass is tune-deaf. Music, as perceived by any person, consists of units of his psycho-physical pitch series contiguously united, and, therefore, very few men are capable of appreciating music absolutely for its own sake; hence, highly classical music, which appeals almost entirely to this faculty, is not popular. A subject is interesting

according to the number and predominance of the faculties to which it appeals; hence the preference by classes of individuals, for sentimental, comic, martial, or sacred music.

Though this faculty is essential to a musician, it does not *make* a musician; many other faculties are required, which vary according to the type selected. A composer must be able to perceive the combinations of notes which appeal to different faculties; a violinist must have an accurate motor memory for the movements required.

When the faculty is largely developed, its possessor is able to discriminate between minute variations in pitch, and can remember an air correctly. We sometimes find a rough, uncultivated child who is able to whistle a tune with greater precision and accuracy than many cultivated persons who have been taught by the best masters, and accustomed to strum on the piano for many hours daily. A person with a small development of this faculty thinks music 'a noise,' and takes no pleasure in it, not being able to distinguish one tune from another.

The physical intensity of a musical note is represented by its loudness. The special memory developed by this faculty is well illustrated by the following, which is taken from Holmes's 'Life of Mozart':

'You say you should like to know my way of composing, and what method I follow in writing works of some extent. I can really say no more on the subject than the following, for I myself know no more about it, and cannot account for it. When I am, as it were, completely myself, entirely alone, and of good cheer—say, travelling in a carriage, or walking after a good meal, or during the night when I cannot sleep—

it is on such occasions that my ideas flow best, and most abundantly; *whence*, and how they come, I know not, nor can I force them. Those ideas which please me I retain in my memory, and a accustomed (as I have been told) to hum them to myself. If I continue in this way, it soon occurs how I may turn this or that *morceau* to account so as to make a good dish of it—that is to say, agreeably to the rules of counterpoint, to the peculiarities of the various instruments, etc.

'All this fires my soul, and, provided I am not disturbed, my subject enlarges itself, methodised and defined; and the whole, though it be long, stands almost complete and finished in my mind, so that I can survey it like a fine picture, or a beautiful statue, at a glance. Nor do I hear in my imagination the parts successively, but I hear it, as it were, all at once. What a delight this is I cannot tell! All this inventing, this pondering, takes place in a pleasing lively dream. Still the actual hearing of the *tout-ensemble* is, after all, the best. What has been thus produced I do not easily forget; and this is, perhaps, the best gift I have my Divine Maker to thank for.

'When I proceed to write down my ideas, I take out of the bag of my memory, if I may use that phrase, what has previously been collected into it in the way I have mentioned. For this reason the committing to paper is done easily enough; for everything is, as I have said before, already finished; and it rarely differs on paper from what it was in my imagination. At this occupation I can therefore suffer myself to be disturbed; for whatever may be going on around me I write, and even talk, but only of fowls and geese, or of Gretel, or Barbel, or some such matters.'

nating between various tastes as in their perception of other qualities described, one perceiving a difference between two flavours, when another declares that they are exactly the same.

As this faculty inclines its possessor to seek for impressions peculiar to it, it is the faculty of the epicure and the glutton. The epicure restrains his appetite, but takes care that everything that he does eat shall be of the very best, and to exactly suit his palate; whilst the glutton indulges his gormandizing propensities without restraint, but they both remember easily everything connected with food, and spend a large portion of their time in thinking of and enjoying the pleasures of the table.

8. *Faculty of Tactile Perception.*

This faculty plays a very important part in aiding the mind to form correct ideas of the qualities of surrounding objects. This faculty has, apparently, functions in common with the faculty for the perception of visible form; but this is not really the case: the impressions derived by touch, and those derived by the sight, are quite distinct, and not in any way interchangeable. A blind man does not derive impressions from touching objects, similar to those obtained by a person who possesses his sight, but only similar to those obtained by a normal man with his eyes shut. It is impossible to explain to a man who has been blind from birth how form could be represented on a plane surface. A man who has been blind from birth, but has afterwards gained his sight by an operation, has to go through the process of association of impressions which takes place in the normal infant; he finds that

the impressions he has gained of form and size, by touch, in no way aid his sight; he has to feel the object before he is able to recognise it. (See p. 11.)

All ideas gained through touch are primarily due to a mental perception of the condition of the nerves in relation to external objects. The physical series is represented by the terminations of the nerves, the psycho-physical series by the capability of being able to distinguish two adjacent stimuli as two impressions. The physical intensity of an impression depends upon the amount of pressure employed.

The tactile sensibility varies in different parts of the body.

The following is a table compounded from the results of Weber's experiments, and taken from Kirke's 'Handbook of Physiology':

Table of Variations in the Tactile Sensibility of Different Parts.

The measurement indicates the least distance at which the two blunted points of a pair of compasses could be separately distinguished.

	Inch.
Tip of tongue	$\frac{1}{24}$
Palmar surface of third phalanx of forefinger	$\frac{1}{12}$
Palmar surface of second phalanges of fingers	$\frac{1}{6}$
Red surface of under-lip	$\frac{1}{6}$
Tip of the nose	$\frac{1}{4}$
Middle of dorsum of tongue	$\frac{1}{3}$
Palm of hand	$\frac{5}{12}$
Centre of hard palate	$\frac{1}{2}$
Dorsal surface of first phalanges of fingers	$\frac{7}{12}$
Back of hand	$1\frac{1}{6}$
Dorsum of foot near toes	$1\frac{1}{2}$
Gluteal region	$1\frac{1}{4}$
Sacral region	$1\frac{1}{2}$

	Inch.
Upper and lower parts of forearm	$1\frac{1}{2}$
Back of neck near occiput	2
Upper dorsal and mid-lumbar regions	2
Middle part of forearm	$2\frac{1}{2}$
Middle of thigh	$2\frac{1}{2}$
Mid-cervical region	$2\frac{1}{2}$
Mid-dorsal region	$2\frac{1}{2}$

Ideas of real size and form are gained partly through this faculty, and partly through that of muscular perception; thus, an estimation is formed of the number of nerve-ends touched, in the position which the hand happens to be in at the time. An object is said to be rough when the ends of the nerves over a certain cubic space are irregularly stimulated; flat when all are equally stimulated.

Like all the other faculties, it may be developed by continual use, and its function accordingly increased, as in the case of a blind man, who, as he cannot correct his tactile impressions by his visual ones, has to remember them, as received. In many blind men the special memory becomes so developed as to enable them to discriminate between objects in which the difference of form is so slight as to be imperceptible to the eye.

The following is an example of this special memory. A boy, blind from his birth, was accustomed to distinguish between objects slightly varying in form, such as oranges; after having been allowed to feel an orange carefully, this was mixed with a number of others, and he then searched for it; if it were not amongst those given him, he would say so, and not take one of the others. At one time, the orange was put into a market-basketful containing fifty others, and

was found successfully by him. His friends used to try to puzzle him, but were not able to do so.

9. *Faculty for the Perception of Temperature.*

By means of this faculty, ideas are gained of the temperature of surrounding objects, and so the body is protected from the injurious effects of heat and cold. In a still more marked manner, than in the preceding faculties, does the psycho-physical differ from the physical heat series, temperatures between 50° F. and 115° F. being readily distinguished, whilst those much above or below these points give rise to pain. Very high or very low temperatures alike produce a burning sensation.

There is an experiment which is often alluded to as showing that our knowledge of temperature is only relative; namely, if the right hand be plunged into very hot water, and the left into very cold, on transferring both hands to a basin in which the water is moderately warm, the water feels cold to the right hand and warm to the left. A similar experiment may be made with the other faculties; thus, if one person be taken from a well-lighted room, and another from a dark room, and both put into one moderately lighted, the room will appear dark to the first and light to the second. How accurately a special memory may be developed by this faculty, is seen in the case of practised bath-attendants, who can often tell the temperature of a bath to half a degree.

10. *Faculty of Muscular Perception.*

Through this faculty we perceive the condition of the muscles. This is the sensory faculty of the muscles,

and by means of the special memory formed by it, movements are in a great degree improved. It is by means of this faculty that we estimate the weight of an object, the amount of muscular force necessary to raise an object being estimated, and compared mentally with a known weight. Of course, weights are arbitrary methods, but a man with this faculty large would find no difficulty in remembering the weight of a pound.

It is by means of this faculty, also, that the form and size of objects are partly made out; thus, if an object be grasped, an estimation of the size of the object can be made from an idea of the distance between the fingers. The physical series consists of the difference in a muscle between relaxation and complete contraction, the psycho-physical series consisting of the degree of contraction capable of being estimated.

The special memory is well exemplified in men who can estimate weights correctly; as a grocer or tobacconist, who is able to take up the exact amount required to turn the scale.

The function of each of the preceding ten faculties is easy to understand. Each of the special senses is employed in elaborating impressions, so that the mind shall be cognizant of the qualities of external objects. When these impressions have been conveyed to the sensory memory, a perceptive faculty is required to bring each quality before the mind, and as each of these faculties is only concerned with one sense, if that sense be lost, then the faculty cannot be employed in perception.

The functions o. the following faculties are not so easily appreciated, as they do not depend upon a single sense, and require that an impression should

have been conveyed to the mind, by one or more of the preceding faculties, before they can be influenced. Each gives rise to certain ideas, and the memory of these ideas is stored up in the sensory memory, as well as the memory of qualities which are more easily recognised.

11. *Faculty of Perception of Position* (Locality).

This faculty is concerned with the perception of relative position.

It makes its possessor a sort of natural compass; it is not dependent upon any one sense, in particular. It is not entirely dependent upon sight, as it is one of the most powerful faculties in regulating the movements of blind people, and even a slight examination of its functions, in ordinary life, will be sufficient to show that this is the case. If two blind men were to go into Epping Forest, one having a large and the other a small faculty of locality, and they both wandered into the thick of the forest, the man with large locality would be easily able to find his way out, having carried in his head the *direction* they had pursued.

Locality is a faculty which appears to be more developed in savages and animals than it is in persons belonging to civilized communities. It is also larger in a provincial dweller than in a citizen of a large town, as we should naturally expect. An animal or savage would soon get lost in the forest if it were not for this faculty to guide them back to their starting-point. The faculty of form is often substituted in a way which illustrates the rule of substitution in as complete a manner as could be desired. Thus, a man of observa-

tion, with this faculty deficient, carefully notices landmarks, by means of which he is able to find his way. Thus, he notices a certain tower, or prominent landmark, when he starts out, and when wishing to return, he looks for the same point.

The extraordinary development, as shown in dogs, will be spoken of in a future chapter. Savages are capable of finding their way across country and back again in a most wonderful manner.

I find that, as a rule, literary men have a very poor development of this faculty; and this is what we should naturally expect, as they would be more likely to find their way by the names of streets and sign-posts, therefore, scarcely using the faculty. Hence the difficulty which a literary man of this kind must find in trying to aid his memory by this faculty. For nearly every artificial system, from that of Simonides up to the present time, has been, in reality, based on this faculty. The way in which mnemonics was discovered is really only an exhibition of its functions. Simonides, a Grecian poet, after reading a poem to an assembled company, went out; a short time after he had left, the roof fell in and killed all present. Then came a difficulty; the persons were so mutilated that it was utterly impossible to recognise them, and so the citizens were anxious for some means of identifying their friends. Simonides then stepped forward, and said that he had noticed where each person sat, and by this means they were recognised. He then thought that a system might be constructed, by means of which a series of ideas might be remembered by associating each with some well-known object, such as those met with in a house. This he found answered (for his purposes), and so

mnemonics was founded. This faculty, and the fact of turning figures into letters, forms the basis of nearly every system. The possession of this faculty by an 'originator' of a system is shown by his lectures on the subject. His great power seems to consist in being able to repeat a long string of words, backwards, forwards, or in any order: or if asked, for instance, the sixth word, to be able to reply. The same with long lists of figures. Very amusing, as an entertainment, perhaps, but absolutely useless for all practical purposes. But this power is only the natural function of locality, which perceives the relative positions of objects. I have often been told by a man with a large faculty of locality, that he can remember exactly whereabouts on a page an idea or a name is to be found, whilst not being able to recollect the name itself.

The physical series of position is admirably illustrated by a compass, the observer being represented by the pivot on which the needle turns. Innumerable degrees can be made between the points of the compass, as one passes by imperceptible gradations into another; thus, the space between N. and N.W. could be subdivided any number of times, the circumference being enlarged if necessary. The psycho-physical series is made up of the units of position capable of being perceived by the observer.

Like the rest of the faculties when large, this creates a desire for its exercise, and this generally results in the individual wishing to exercise it in perceiving the relative position of objects all over the world, and so creating an inclination to travel. It is, therefore, the faculty of the explorer and traveller.

The following shows the special memory developed by this faculty.

Francis Luarez could repeat all St. Augustine's works, and make quotations, citing the number of the page and the line where they could be found.

This is also an example of a prodigious memory for words.

12. *Faculty of Time.*

This faculty has the function of perceiving periods of time, thus creating a sort of natural chronometer of the individual. It depends upon no sense in particular. A man, with this faculty large, is able to remember periods of time, and, being able to form a correct estimation of time, is only unpunctual through a fault of his own. It is surprising how accurately some men are able to tell the exact time of day without referring to a watch. Time in music also comes under the same faculty, because here a correct estimation of time has to be formed, so that the notes may be played in correct relation to the time as shown by the metronome. In keeping time, in walking, we take a step in a certain definite period of time. The physical series of time is evident enough, each unit passing by imperceptible gradations to another; a second of time can be subdivided beyond conception, as, for instance, the period of time required by light to pass through the space of a yard. The psycho-physical time series is made up of units, which the observer is able to perceive, as distinct from one another.

The special memory is well seen in those persons who are able to remember the chronological order of events easily, because they are associated with ideas of

periods of time. The special memory is also required to enable a person to say how long a given piece of work will take him to do.

It is well illustrated by the case of a lady who could remember time in preference to anything else; when asked whether she remembered a certain event she would reply: 'Yes, it took place at twenty minutes past four on the thirtieth of June, eighteen hundred and seventy-five.'

The most remarkable memory, associated with this faculty, that I have come across, was that of a man who in other respects had a very poor memory, but with regard to time and anything connected with it, he had a marvellous memory; his favourite reading was time tables, and he knew nearly every time table in Great Britain.

13. *Faculty of Number.*

This faculty depends upon no sense in particular; in fact, it may receive impressions from any sense—sight, by seeing a number of objects; hearing, smell, taste, and touch, by a numerical repetition of their respective stimuli.

There is no more necessary connection between the form representing the number seven and the number itself, than there is between the word and the corresponding sound. The reason that figures are so easily remembered by a person possessing this faculty large, is due to the fact that all impressions are stored up in the memory, and the association between the written figures and the ideas remembered by this faculty are so strong, that the one easily revives the other. Thus, the originator of the Arabic numerical forms, might,

with equal propriety, have made the form O represent the number nine, and *vice versâ*: and then, on seeing the form O, the number nine would, at once, occur to the mind. I wish to show that the whole system is artificial, and that there is no necessary association between the forms and the numbers they represent, as until this is done the function of this faculty will not be understood. Many of our most distinguished writers, as the following example will show, have fallen into this error, saying that the memory for figures is only a special development of the memory of form, brought about by the inclination of its possessor. Thus, Professor Bain says that Bidder could quite as well have learned the Chinese alphabet, if he had *wished* to, instead of remembering numbers in the way he did. But, I will take the very example that Professor Bain gives; he quotes Bidder's *own account* of the origin of his arithmetical faculty as follows:

'I have endeavoured to examine my own mind to compare it with that of others, and to discover if such be the case; but I can detect no particular turn of mind beyond a *predilection for figures*, which many possess almost in an equal degree with myself.'

He then relates how, under the influence of such a predilection, he gave himself up to the study of numbers, learning first the ordinary multiplication table by making lines and squares of peas, marbles, and shot, and then enlarging upon this, until at last his own multiplication table, actually in his memory, rose to a million.

I cannot see how Professor Bain has arrived at the conclusion that Bidder had a remarkably accurate memory for arbitrary visible forms; thus, there is no

mention of a *written* figure being used in the process. Bidder says he used marbles, shot, and peas; in fact, he does not say whether, at that time, he knew how to represent numbers on paper; the probability is that he did not, or he would have used pen and paper, instead of marbles and shot.

Again, other forms may be used to represent numbers (as the Roman notation), and calculations can be performed with perfect ease, by means of them, or words only, as are employed by many savage nations. Many working-men who cannot read or write, and who are not able to understand the meaning of a figure, are still able to perform the necessary calculations required in monetary transactions.

The function of this faculty may then be said to be the perception of ideas of number, no matter how this information is obtained; thus, if there be one orange on the table, and I add another to it, I have doubled the number, and a certain idea occurs to the mind of a child, long before it is able to be taught anything about numbers; if I add two more oranges, I have again doubled the number, and given rise to another idea, namely, that there are *four single oranges;* this faculty perceives those ideas. In the same way, a succession of sounds, odours, taps on the skin, or tastes, are remembered as so many units. It will be seen that our numerical notation might be entirely altered without any practical difference; thus numbers, at present, cease to be represented by single figures after nine, but, except as a method of convenience, there is no necessity for this; thus, the number ten might be represented by 𝔗, and the number eleven by 𝔓, with equal propriety, the repetition commencing at twelve.

With regard to the special memory developed by this faculty, all impressions in any way connected with numbers are easily remembered; the arithmetician can as easily remember the arbitrary forms and sounds representing numbers as a correspondingly accurate musician can the arbitrary forms representing musical notes, and so is able to change the one into the other easily, the real remembrance being the number of units into which all figures are mentally changed.

The following are some good illustrative examples.

Zerah Colburn, the son of an American peasant, first gave signs of his arithmetical talent when under six years of age, and before he received any instruction in writing and arithmetic, and, therefore, his memory could not be a special development of the memory for arbitrary form. He was brought to London in 1812, when eight years old, and his powers tested by several mathematicians, among them Francis Bailey, from whose account the following examples are selected, and related by Dr. Carpenter, in his excellent work on mental physiology.

'He raised any number consisting of *one* figure progressively to the *tenth* power; giving the results (by actual multiplication, and not by memory) faster than they could be set down in figures by the person appointed to record them. He raised the number 8 progressively to the *sixteenth* power; and in naming the last result, which consisted of fifteen figures, he was right in every one. Some numbers consisting of *two* figures he raised as high as the *eighth* power, though he found a difficulty in proceeding when the products became very large. On being asked the *square root* of 106,929, he answered 327 before the original number

could be written down. He was then required to find the cube root of 268,336,125, and with equal facility and promptness he replied 645.

'He was asked how many *minutes* there are in forty-eight years; and before the question could be written down, he replied 25,228,809, and immediately afterwards he gave the correct number of *seconds*.

'On being requested to give the *factors* which would produce the number 247,483, he immediately named 941 and 263, which are the *only* two numbers from the multiplication of which it would result. On 171,395 being proposed, he named 5 × 34,279, 7 × 24,485, 59 × 2,905, 83 × 2,065, 35 × 4,897, 295 × 581, and 413 × 415. He was then asked to give the factors of 36,083, but he immediately replied that it had none, which is really the case, this being a prime number. Other numbers being proposed to him indiscriminately, he always succeeded in giving the correct factors, except in the case of prime numbers, which he generally discovered almost as soon as proposed. The number 4,294,967,297, which is $2^{32}+1$, having been given to him, he discovered (as Euler had previously done) that it is not the prime number, which Fermat had supposed it to be, but that it is the product of the factors 6,700,417 × 641. The solution of the problem was only given after the lapse of some weeks; but the method he took to obtain it clearly showed that he had not derived his information from any extraneous source.

'When he was asked to multiply together numbers both consisting of more than three figures, he seemed to decompose one or both of them into its factors, and to work with them separately. Thus, on being asked to give the square of 4,395, he multiplied 293 by itself,

and then twice multiplied the product by 15. And on being asked to tell the square of 999,999, he obtained the correct result, 999,998,000,001, by twice multiplying the square of 37,037 by 27. He then of his own accord multiplied that product by 49, and said that the result (viz., 48,999,902,000,049) was equal to the square of 6,999,993. He afterwards multiplied this product by 49, and observed that the result (viz., 2,400,995,198,002,401) was equal to the square of 244,999,759.

'On being interrogated as to the method by which he obtained these results, the boy constantly declared that he did not know *how* the answers came into his mind. In the act of multiplying two numbers together, and in the raising of powers, it was evident (alike from the facts just stated, and from the motion of his lips) that *some* operation was going forward in his mind; yet that operation could not (from the readiness with which the answers were furnished) have been at all allied to the usual modes of procedure, of which, indeed, he was entirely ignorant, not being able to perform on paper a simple sum in multiplication or division. But in the extraction of roots, and in the discovery of factors of large numbers, it did not appear that any operation *could* take place, since he gave answers *immediately*, or in a *very few seconds*, which, according to the ordinary methods, would have required very difficult and laborious calculations; and *prime* numbers cannot be recognised as such by any known rule.'

Dr. Willis (*Philosoph. Society's Trans.*) tells us that he was able to perform the most extraordinary calculations without the aid of pen or paper, simply mentally, and by remembering the numbers; in this way he was able to extract a root to forty places. He was tested

by a foreigner, who dictated to him, in the dark, a number consisting of fifty-three figures, and he found the square root to twenty-seven places, and dictated it from memory twenty days after, never having written any part of it down.

Numerous other cases have been related to me of lesser degrees of this faculty occurring in otherwise ordinary individuals, of which the following is an example.

A gentleman possessing great natural talent for mental arithmetic was able to add up a column of figures, consisting of three figures in the pounds, with shillings and pence (the column being of the ordinary day-book length), with scarcely more than a glance at the page, just passing his pen rapidly up the column, and then writing down the whole result, commencing at the pounds. But he found great difficulty in working out sums which depended upon other faculties as well as this, such as those exemplifying the rule of three, that is, any sum which required in the working out more than a perception and recollection of ideas of number. Before this can be thoroughly understood, the chapter on remembrance and recollection must be read, when these examples will be again referred to, and the similarity between them and that of Mozart, and both with the remembrance of words, will be, at once, seen, the accounts given being of the greatest value, as they are written by the men themselves.

I have discussed this faculty at considerable length, because it shows in a clearer manner than any other the nature of an ultimate faculty. Thus, it does not depend upon any special sense, and so cannot be explained in the manner that many psychologists explain the other

faculties, namely, that there are special psychological sight and other sense centres, and that those persons who can remember colour better than form have the sensibility of the retina most acute, and that form perception depends upon the muscles of the eye. Now, a man who possessed only one sense, could calculate; thus, if he were blind, deaf, and dumb, and had lost his taste and smell, he would still be able to calculate, and have ideas of number with marbles, matches, or pins. In short, it forms a clearly defined, primitive faculty of the mind. An example of its extreme deficiency is to be found in George Combe, who, in spite of the utmost perseverance, failed to master the multiplication table.

14. *Faculty for the Perception of Beauty.*

This faculty perceives the beautiful.

If we analyze a number of individuals, we shall find that there is a more or less definite standard of beauty. Nearly everyone agrees in appreciating the highest types of beauty. A very beautiful woman creates universal admiration. There is a faculty for the estimation of this beauty, as there is for all other qualities. If it were not so, we should only appreciate anything that we possessed according to the use that could be made of it, and would regard all ornament as unnecessary and superfluous. Like the rest of the faculties, when large, it influences its possessor, before education could have had any influence.

The standard of beauty varies in different countries, and this we should naturally expect, there being various modifying influences, and various developments of the faculty, which is one of those which have been par-

ticularly affected by civilization. If this faculty did not exist, objects would be appreciated according to the gratification they afforded the other faculties, as indeed they are, when there is a deficiency in this respect. What a difference there is between individuals, in the midst of the finest scenery; some will be admiring it with rapture, others fast asleep, drinking, or playing cards. Can we expect the latter to remember it? It is the faculty of the poet, and in combination with the other faculties adds the ornamental to the useful, and produces effects which are generally admired, thus showing that the admirers possess the faculty in a sufficient degree to be able to admire, if not to produce. When in excess, the person is too fond of the beautiful, and spends all in outside show, beauty being the first essential in his eyes, to the exclusion of better qualities.

The associated special memory is obvious.

15. *Faculty of Incident* (Eventuality).

This faculty is concerned with the perception of events. It depends upon no individual sense.

It may be explained as follows: Supposing a man is walking in the street, he may see a dog run over by a cart. Under these circumstances he has seen a dog, he has seen a cart; but he has seen more—he has seen *the cart run over the dog.* It is the function of this faculty to give rise to the idea of this occurrence. When he has seen this happen, certain ideas occur to him apart from any emotion; definite previous impressions are revived, and these ideas are retained. The same ideas may be obtained by reading a similar

orators, but fails utterly when he tries to give an address on his own account.

Gustave Doré is said to have been a perfect mimic, being able to accurately reproduce the gestures and expressions of a person speaking by his side.

20. *Faculty of Motor Co-ordination.*

This faculty is concerned with the organisation of the motor memory and the contraction of the muscles by means of motor impulses. This faculty corresponds to Ferrier's motor centres, taken as a whole, there being special portions for each set of muscles.

By means of this faculty, the person is able to execute the various actions required by the other faculties. Thus, the musician wishes to learn the necessary movements for playing on an instrument; the mechanic, those necessary for the construction of machines, etc.

When this faculty is large, its possessor will be able to execute movements easily, if he be able to appreciate how those movements should be performed.

21. *Faculty of Acquisitiveness.*

This faculty creates a desire to acquire; what is to be acquired, depends upon the other faculties. Thus, with the selfish faculties well developed, there is a desire to acquire something which will gratify those faculties. Acquisitiveness is as much shown by the monkey, who takes as many nuts into his mouth as he can get, before commencing to eat one, as by the miser, who saves the thousands which will never benefit him. As money, comparatively useless in itself, is the medium by which property of all kinds is exchanged, it becomes for the time being the object of pursuit, and

may, by a perversion of the faculty, become the *sole* object of labour, parting with any of it causing great grief.

The following case will show the special memory developed by this faculty, and illustrates its function very well.

A lunatic with a disposition to acquire, but very weak-minded on all other points, was still able to tell with great accuracy anything immediately connected with money, always being able to tell the prices of various articles, and places where an advantage might be obtained in buying.

Kleptomania is probably due to an excess or perversion of this faculty, where an individual, apparently sane in other respects, will steal anything he can lay hands on.

Instances are related of men who have developed this passion for acquiring to such an extent that they have collected quantities of the most useless articles, as oyster-shells.

22. *Faculty of Perseverance.*

This faculty creates a desire to finish whatever is commenced, and not to leave it half or three-quarters done. At first sight, its function appears to be synonymous with that of firmness, but a further examination will show that this is not the case. I have often noticed that the greatest perseverance is often found in otherwise weak-minded individuals, with scarcely a will to call their own, whilst a very obstinate man may be most lax one day, on a point that he was most obstinate about a few days previously, a sign of *resistance* being sufficient to arouse his firmness. Perseverance keeps

on working at an easy subject; firmness often gives up when difficulties are surmounted.

23. *Faculty of Destructiveness.*

This faculty gives energy of character, and a desire to overcome obstacles. When combined with courage it makes a true soldier.

24. *Faculty of Courage.*

This faculty is well explained by the name, and is best illustrated by a comparison between a courageous and a cowardly man, who are in other respects the same. Thus, supposing a number of people are standing on a pier, and one of the number goes to the edge and falls into the water, there will be an obvious risk in attempting to save him; this risk would appear so great to many men that they could not force themselves to jump into the water. Courage gives a man the *requisite*, necessary to enable him do so, and coolly. This faculty may be said to have the function of preventing fear from influencing the mind, in the same way as self-control prevents a man from acting from impulse in the way he would in the absence of its influence. To perform a dangerous action, without knowing that it is dangerous, is not courageous.

25. *Faculty of Cautiousness.*

The two words, 'take care,' express the action of this faculty. A person possessing it large is timid, cautious, and afraid of consequences (unless he possesses still larger courage); he always looks at the worst side of a scheme, and the dangers to be encountered, and often, through spending so much time in

fearful anticipation, is not ready when the danger actually comes. An excess leads to procrastination, and on this account the individual is usually far behind others; he is afraid he will not be able to finish a subject, and so often never commences at all.

26. *Faculty of Secretiveness.*

This faculty conveys an idea to the mind, prompting the individual to conceal. It is the faculty which prevents any of the others making their knowledge known. When properly applied, its function is very important, and prevents an exhibition of feeling in the wrong place, and leads a man to think before he speaks or acts.

When large, it leads to concealment for its own sake, and when perverted, to lying and duplicity of all kinds.

27. *Faculty of Love of Praise.*

This faculty influences an individual to desire the approbation of his fellow-creatures, and so gives rise to politeness, ostentation, and all the other methods by means of which praise is gained.

When large and with a small mind, it gives rise to vanity; with a large mind, to ambition. Vanity is a very different sentiment from pride. A man may be very vain, and yet not feel satisfied with himself; he may be anxious for, and pleased with, the praise of the lowest, whilst the proud man would only feel disgusted when praised by a man of whom he did not approve. The two sentiments, however, are generally associated.

28. *Faculty of Firmness.*

This faculty gives power to the will, and inspires

its possessor with a determination not to be driven. It does not follow in the least that a man who has large firmness should be consistent; perseverance gives consistency. An obstinate man is often very easily led.

29. *Faculty of Self-Esteem.*

This faculty inspires an individual with a belief in himself, and so gives self-confidence. It is the faculty of the commander and leader. All the various self-complacent feelings can be traced to be modifications of this faculty by the rest of the mind.

When large it gives rise to pride and arrogance.

30. *Faculty of Amativeness.*

This faculty creates an affection for the opposite sex. Its functions are sufficiently described by the name, and are well known to everyone.

31. *Faculty of Parental Love.*

This faculty gives rise to a fondness for children and animals, and is usually more developed in the female than in the male.

32. *Faculty of Sociality.*

This faculty creates, in a person, a desire to associate with his fellow-creatures, and a dislike for his 'own company.' A person with it large, would rather have the company of someone he disliked, than no company.

33. *Faculty of Love of Truth.*

This faculty is that which prevents a man from

telling a lie. Some of the greatest hypocrites are very averse to telling a direct lie; they prefer to allow another person to get himself into trouble; they hold up their hands and look at you with astonishment, when asked not to repeat something, meaning to tell it to the very next person they meet; and, of course, they never *said* they were not going to repeat what had been told them.

It creates a sense of fairness and justice, and a belief in right as *right*, and makes a person true to his own convictions, whatever they may be. Its motto is 'Right for right's sake'; that of secretiveness being 'Honesty is the best policy.'

34. *Faculty of Hope.*

This faculty influences the mind to believe that circumstances will turn out as expected, and prevents a person from desponding when in trouble. When this faculty is very large its possessor is liable to fail in his undertakings, through being over-sanguine, and not taking sufficient pains to secure his success.

35. *Faculty of Spirituality.*

This faculty causes a man to believe in the supernatural, and when it is large he readily believes in ghosts, and is very superstitious, attributing every occurrence, no matter how trivial, to an unseen influence.

36. *Faculty of Veneration.*

This faculty inclines a person to worship and reverence. It is the faculty which produces a feeling of

respect for those who are better off than ourselves, and for the great and magnificent.

37. *Faculty of Benevolence.*

This faculty gives rise to a desire to benefit others, and is therefore the faculty of the true philanthropist. When large its possessor is of a very self-sacrificing disposition.

CHAPTER VII

REMEMBRANCE, RECOGNITION, AND RECOLLECTION

REMEMBRANCE is the term applied to the process when ideas and circumstances occur to the mind without mental effort, as, for example, those which have become part of ourselves. Thus, the names Shakespeare, Milton, and Byron suggest to us definite ideas without mental effort. Still, it is only a process of memory; at one time, we did not know who they were, though we can hardly recollect the time.

Recognition is applied to persons and objects, when we look at an object and feel that we have seen the same before and in association with certain ideas. Thus, we look at a picture, and *recognise* it as being painted by a certain artist. That is, we see in the picture some points which make us convinced from the style that *this* artist has painted it. We *recognise* Mr. Brown as being the man we met at Brighton under certain circumstances. Recognition is, therefore, a conscious association of a past with a present impression, special faculties perceiving that the impressions are similar, and conveying this idea to the mind. Impressions are brought before the mind whether the process of recognition takes place or not, but in the latter case they remain unassociated.

Recollection is different from the above, insomuch

as it is a process in which the mind is primarily engaged. Thus, a man is asked, 'Do you remember when it was we went for that trip up the river?' 'No,' he replies, 'I don't remember,' and then thinks. Oh! it was about the time I received that letter from R——. Ah! now I remember; that was on a Monday, and we went up the river on the Wednesday.' Thus, by a mental reviving of previous impressions, an association is found, and the required date remembered.

The relation of the mind to the centres of memory has already been discussed, and the seat of the sensory memory being entirely below the plane of consciousness, there are certain definite laws which govern the process of perception by the mind of the impressions in the sensory memory centres.

First Law of Remembrance.

All impressions tend to revive those of a similar character, previously received; but an impression in the sensory memory will not be brought before the consciousness if its psychical intensity does not reach a certain definite standard. This psychical intensity is attained by the association of impressions representing similar members of a psycho-physical series contiguously combined in a similar manner.

Second Law of Remembrance.

When an impression is received similar to one received previously, unless the previous impression be revived at the same time, both impressions will remain separate; whereas, if the previous impression be brought before the consciousness and recognised as similar, an association of the two impressions will take place.

Third Law of Remembrance.

The revival of a component of an impression tends to the revival of the remaining components, and the revival of any impression tends to the revival of other impressions received about the same time; but unless these reach the necessary standard of psychical intensity they will not be brought before the consciousness.

The first law of remembrance governs the revival of an impression in the sensory memory by other impressions received at a subsequent date, either as fresh sensory impressions or by the action of the mind. The word 'similar,' as applied to impressions as *perceived*, is only relative, and depends upon the several psycho-physical series, each of which differs in individuals; thus, the psycho-physical form series of a Turner or Cuvier is considerably greater than that of an average person. The addition of a large number of units to a series very much extends the number of possible combinations, and, therefore, possible similarities. When a person fails to perceive an obvious likeness between two photographs, it is because he is not able to perceive the individuality of form in which the likeness consists, as shown in the example of the circles (see p. 59). The great difference between impressions, as received by any individual, consists in the variety of the contiguous combinations, and as the number of similar combinations in two impressions increases, so does the probability of revival; thus, a man who was not able to recognise an acquaintance when he met him again in different attire, would probably have easily done so, had his friend had on the same clothes as he had previously worn. It will be seen, therefore, that if an individual has a large faculty of any kind, he

will be able to perceive differences between impressions which are not apparent to another person, less gifted; thus, one man with large form might see a hundred differences between two faces, whilst another person was only able to see ten.

This law governs the revival of impressions by true similarities, and shows how it is, all impressions are not revived when a permanent memory is retained of them. We may see a person or hear a tune that we have heard before, with or without recognising him or it; but unless we recognise them, it is obvious that no revival has taken place.

By a 'true similarity,' a physical, and not a psychical similarity is meant; thus, if a picture be twice shown to any person, the impressions received by him of it are physically similar, and a similarity of this kind must be distinguished from an *artificial similarity*, as, for instance, that between two words representing the same idea.

The revival of any impression may take place directly or indirectly. By the 'direct revival' of an impression is meant, that an impression, when passing through the sensory memory centre on its way to the mind, revives one or more similar impressions in this centre, and all are perceived by the mind at the same time. By the 'indirect revival' is meant, that the revival takes place through the intervention of the mind, and is, therefore, a conscious process. The first, or direct, revival is remembrance; the latter, or indirect, revival, recollection. Recognition may be direct or indirect.

As the seat of memory is entirely below the plane of consciousness, the mind is not conscious of the processes of the direct revival, and they are not under

voluntary control; thus, we cannot help remembering that a boat *is* a boat, or a fire *is* a fire, when we see either. The following is an illustration of the fact that we are not conscious of the processes which take place in the seats of sensory and motor memory, otherwise than by the judgment.

It is very common to hear a person say, on entering a room full of strangers, 'I don't know what it is, but I can't help thinking of X——,' and then, perhaps, he thinks no more about it, until he is told that X——'s brother is in the room, or he puzzles over the matter, and, at last, says, 'I know, it is that man over there who reminds me of him.' What occurred in these cases was this, the similarity of that portion of the present impression which represented X——'s brother, revived the impression of X——, which was accordingly brought before the mind; here the process may stop, or the observer may compare the impression of X—— in his mind, with the impression he is receiving of the assembled company, and then notice the similarity between it and that of X——'s brother, and he naturally concludes that seeing X——'s brother brought X—— to his mind.

By the third law of remembrance, a component of an impression being revived, tends to the revival of the remaining components, and this, taken with the process of the direct revival, shows how the ideas associated with words, at once occur to the mind when heard; thus, words which are, *as perceived*, contiguous combinations of psycho-physical articulate sound units, revive similar combinations and the associated ideas. There is scarcely any mental labour involved in the process of the direct revival, compared with that required when the process is indirect.

The process of the indirect revival takes place through the intervention of the mind, and is, therefore, a conscious process, and may be more or less laboured; thus, a man wishing to express a certain idea, may have the requisite words occur to him at once, or only after a period of thought. The way in which the indirect revival takes place is this: a man wishes to express certain ideas as words, those ideas revive similar ideas from the sensory memory with the associated words.

But, before an impression can be brought before the consciousness, either directly or indirectly, it must obtain a certain degree of psychical intensity; therefore, an intense impression will be easily revived, but a feeble impression is not likely to be again brought before the consciousness.

The required sum of intensity may be attained by:—

1. The primary impression being very intense, though the reviving impression be feeble.

2. The primary impression having been of moderate intensity, but having become very much intensified by conscious revival, so that, at last, a very feeble impression will revive it.

3. Both impressions may have moderate intensity, but the combined sum be just sufficient.

4. The primary impression may be very feeble, but the reviving impression of great intensity.

The intensity of a primary impression depends upon the intensity of the perception, and, therefore, anything which influences the perception influences the resulting intensity of the impression perceived.

The intensity of a perception is influenced by the size of the perceiving faculty, the number and import-

ance of other faculties employed at the same time, and the amount of nervous force present in the faculties.

Raising the intensity of any impression is a process in which a great expenditure of nervous force takes place, and, therefore, when the nervous force is at a low ebb this process is accomplished with difficulty, on account of the intensity of the reviving impression not being easily raised. When a person is composing a letter, the ideas which he wishes to communicate, and which are present in his mind, form the reviving impressions, and, according to the intensity of these ideas, will previously-received similar ideas and the associated words be brought before his mind. The greater the intensity, the more numerous will be the revivals, and, therefore, the more complete will be the opportunity for a choice of words. The condition of the mind varies, that is to say, the nervous force is in excess at one time, and below *par* at another; and the facility of recollection varies accordingly, one factor (the reviving impression) being increased at one time, and diminished at another. The other factor, the intensity of the impression in the sensory memory, varies comparatively very little, and this is well seen in those conditions in which nervous force is at a very low ebb; as in cases of slight sunstroke, epilepsy, and drunkenness, where, though no impression can be retained in the mind even for a few seconds, past impressions are capable of being revived. If this were not the case, an attack of indigestion would convert a sane man into a temporary idiot; as it is, however, dyspepsia often seriously interferes with a man's powers of recollection, so that he feels unable to write a letter requiring any thought, but very little with the process of remem-

brance; thus, though he is not able to write the letter, he is still able to read a novel, or attend a theatrical performance, and perfectly understand either.

It is this effect of the varying degree of nervous force which accounts for a good many of the cases of the so-called 'unconscious cerebration.' Literary men accustomed to much original composition, know perfectly well that they are able to work much more efficiently at one time than at another, and what they failed to remember one day, they recollected with facility on another. An exactly parallel instance is afforded by the case of the woman who spoke Hebrew and Latin when in a fever.

Anything which increases the nervous force increases the power of recollection, and *vice versâ*.

Are we to say that a man has unconsciously cerebrated, because he is able to remember a name after taking a little brandy, which he could not before? The brandy has temporarily increased the circulation in the brain, and accompanying nervous force; that is all.

Impressions belonging to special memories are easily remembered on account of their great primary intensity; thus, Mozart was able to remember the whole of an opera, even to the minutest details; in fact, composed it in his mind, and only wrote it down on paper when he had completed the whole. In the same way, Bidder, Zerah Colburn, and Dr. Willis, were able to remember numbers; and Seneca, Cyneas, and Cyrus, words.

Impressions which are received under circumstances of great importance, that is circumstances in which a large number of important faculties are involved, have great primary intensity.

A little consideration will show the immense importance of the second law of remembrance. Thus, repetition *as such* becomes absolutely useless as a method of learning, unless the consciousness of a previous impression be evolved at the time, or at some subsequent period. If the previous impression be not revived at the time, it is not likely to be revived at any subsequent period, the usual result being that both will be forgotten, excepting, of course, cases in which the impression has great primary intensity, or some strong association has been formed.

Association depends upon the third law of remembrance; thus, all contiguous impressions are associated, because they occupy contiguous portions of the sensory memory.

By the second law, a past impression becomes associated with a present impression if the first be revived at the time of the perception of the latter, because the ideas of the old impression form components of the new, as all sensations and ideas present in the mind at the same time form components of one impression, and, besides, they become directly associated, probably from the nerve-force travelling directly from one cell to the other; for this must take place, or old impressions would never be revived.

When first considering the various processes of memory, I felt sure that the above law must exist, and devised the following experiments to prove that such was the case; the results exceeded my anticipations, and I have since not been able to find any exceptions.

The plane-tree is one of the commonest trees in London; most of the avenues contain large numbers

of them, and nearly all the trees in the quadrangle of St. Bartholomew's Hospital are plane-trees; and yet I have taken a leaf and shown it to numbers of students and other persons, and asked them if they knew what it was. They have all said, 'No; I have never seen anything like it before.' And one, who prided himself on his botanical knowledge, even went so far as to say, 'I am positive I have not, because I always notice everything, and should certainly have remembered if I had.' *Next* day he remarked to me, 'It's very strange my not having noticed it before, but I saw numbers of trees with leaves like the one you showed me yesterday on my way home.'

I had the satisfaction of seeing a student show a plane-tree leaf to several of his companions, all of whom failed to recognise it; and then he consulted the lecturer on botany, who astounded them by saying, 'Oh! it is the leaf of a very common tree, the plane.'

Now, all these persons must have seen numbers ot plane-trees *every* day, and if the association of impressions took place independently of consciousness, through repetition, they would have instantly recognised the plane-tree leaf, on account of the immense number ot times an individual, living in London, must have seen one. But this is not the case; each impression remains distinct and separate from the others, unless combined by an effort of the will, or through directly reviving a previous impression, which becomes subsequently recognised as being similar. Thus, most of the above individuals were accurate observers, and had seen numbers of plane-trees every day without troubling themselves to think whether they had ever seen anything similar before, and not knowing the name of

the tree, such a thought was not likely to arise spontaneously, and they would not think of making an association with anything previously known; so none of these impressions would be likely to be revived, on account of their feeble primary intensity, even by such a strong reviving impression as a leaf of the tree in question. Under the circumstances of some important incident occurring in connection with one of these impressions, it might be remembered.

In the next experiment, the plane-tree again played the principal part, and this shows to what a degree the process may be carried.

I was taking a walk with a relation who was very much interested in botany, and anxious to know the names of the different trees and plants. So I went up an avenue (where nearly every second tree was a plane-tree), and pointed out the various trees and shrubs, mentioning their names, but taking no notice of the plane-trees. I then turned into a side avenue of a similar character, and, having reached the centre of it, stopped in front of a plane-tree, and asked, 'Have you ever seen a similar tree to that before?' and received the answer I expected, 'No, I think that must be a very rare tree. I don't remember ever having seen one like it before.' We were in sight of two or three dozen at the time, and the great surprise expressed, at finding every other tree a plane, was amusing.

The reason I chose a plane-tree, in each instance, was, that very few people know a plane-tree, and so that great combiner of impressions, a *name*, was absent.

It seems, at first sight, incredible that an intelligent man could stand every day for some time amongst half

a dozen trees, and yet not recognise the leaf of one of those trees when shown him; in fact, deny emphatically ever having seen anything like it. I fancy I hear the reader say, 'I should have recognised it at once.' Well, I will try him. Take a piece of paper, and draw a circle carefully, and then fill in, from memory, in the proper positions occupied by each, the Roman figures as seen on a timepiece. Of course he must not previously look at his watch. There is no trick, puzzle, or catch in the above; it is simply a matter of memory, as in the case of the plane-trees. As the reader may care to try the above, I will postpone the explanation.

Before formulating the second law of remembrance, I was for a long time puzzled by the following facts:

1. That when a new disease was described, apparently for the first time, similar cases were soon found by medical men all over the country.

2. That, apparently, very simple facts should have remained unobserved by scientific men and accurate observers for centuries, at last, to be discovered by men of exceptional ability. For example, gravity, the nature of light, the circulation of the blood, the stethoscope, etc.

3. That when a person took an interest in any particular subject, everyone seemed to be talking about it; whereas, previously, as far as his knowledge went, nobody had mentioned the subject before.

The above, and a large number of similar facts, may be easily explained by the above law of memory; thus in the case of the newly-found disease—for example, peripheral neuritis—cases occurred, but were referred to another head; but with the *consciousness of the description* in their minds, medical men at once

recognised them. In all three classes, important facts, not previously known, pass unnoticed; we think everyone is talking about the subject that we have uppermost in our minds, because we pay special attention to anything in connection with it. Now, in the plane-tree experiments, the impressions in each case were in the sensory memory, *but separate*, and one might probably be revived with an appropriate stimulus. Thus, if I had asked one of the students, 'What are the leaves of the trees in the quadrangle like?' if he were at all observant, he would most likely answer correctly, as he would try to think of some definite time, when he was standing in the quadrangle with the trees round him. In the same way with the watch experiment; if the individual think of some definite position in which he has seen a clock, and picture it in his mind, he will probably give the correct answer; but if he do not, *and have not noticed the peculiarity* that the four is represented by IIII on timepieces, and not by IV, he will almost certainly fail; and even if this be put correctly, some other mistake will be made. I have never received a correct answer. Here is a simple fact, lying in most cases undiscovered, though a timepiece is looked at, several times a day, for years. In fact, you may say that for a single object a man has noticed a timepiece more often than anything else, it being generally looked at half a dozen times a day, at the least; and yet in spite of the thousands of times that the clock or watch is noticed particularly, to tell the time, this fact is not remembered. What could be a clearer proof, that repetition *as such* does not intensify impressions? Some will even dispute the fact, and declare that the IV *is* correct, until they see the clock.

I will give one more illustration, and, as in the last case, a clock is the chief object. There is in Bristol a church which has a clock without any figures: in the places where the figures should be, there is, in each case, a single line; in fact, it looks as if the maker had put twelve ones, instead of the proper figures. I have asked a good many Bristol residents if they had noticed anything peculiar about the figures of the aforesaid clock, and they have all with one accord replied, 'No; they are just the same as any other clock.'

When a fact of this sort is once pointed out, it is never forgotten. The individuals who were asked about the plane-tree leaf, recognised plane-trees as they went home, for now there is a conscious association of impressions. The following is an excellent example of this.

When taking a walk with a friend, I pointed out a certain flower in a garden, and told him the name of it: we had a bed of similar plants at home. When indoors, I said to him, 'What flower is there in the bed in the front-garden?' He replied, 'Oh! the same as you pointed out to me to-day. I noticed it for the *first* time as I came in.'

On a practical knowledge of the facts arising from this law, a great many conjuring tricks depend.

With regard to the third law of remembrance, the following, which is related of a distinguished equity judge by Dr. Carpenter, clearly shows how an impression may revive others which have been received about the same time.

'It has frequently occurred to him that "further proceedings" have been taken in a "cause" which he had heard some years previously, and had dismissed

altogether from his mind; he has found himself, in the first instance, to have totally forgotten the whole of the former proceedings, not being even able to recollect that the cause had been previously before him. But in the course of the argument, some word, phrase, or incident has furnished a suggestion, that has served at once to bring the whole case vividly into his recollection, as if a curtain had been drawn away, and a complete picture presented to his view.'

The words in the first case which had been previously heard, were obviously only associated together by being received at the same time, and when one prominent word was revived, the whole was brought before the mind as if a curtain had been drawn away.

As in the case of the revival by similar impressions, if the tendency, which a component has to revive the remainder of the impression, does not cause that remainder to reach the necessary standard of intensity, it will not be brought before the consciousness. In proportion to the intensity of the reviving component, so will its tendency be to revive the whole impression; thus, feeble impressions associated with special memories are usually easily revived; for instance, a man with large acquisitiveness may not be able to remember figures or numbers as a rule, but easily remembers the prices of different articles. This is well illustrated in the process of 'trying back,' where a person having forgotten the second of two consecutive words, tries, often successfully, by repeating the first, and so raising its intensity, to obtain the second.

This 'revival of components' is the origin of a great number of common and curious errors, one component becoming substituted for another, the commonest

error being the substitution of a commonly used for a more rare component. At first sight, there may appear no reason why the word 'glad' should have been written in the place of the word 'sorry' in a letter, as is often the case; but when it is remembered that 'glad' and 'sorry' form components of many impressions, and the first is usually much more used than the latter, and so acquires a greater intensity, the explanation is simple enough; the exact process, by means of which the error is brought about, will be detailed in the next chapter. In the same way, the first word is often substituted for the second of a compound, or of two constantly occurring words.

Recognition.

Recognition is the term applied to the conscious association of impressions, according to the second law of remembrance. The previous impressions required in the process of recognition may be revived directly or indirectly; directly, as in the case of recognising an orange, indirectly, as in trying to recognise a person who has addressed us. Recognition will thus be seen to be at one time remembrance, at another recollection.

A. *Direct Recognition.*

This is the recognition required in the ordinary purposes of every-day life, and is an instantaneous process, the ideas occurring to the mind at the same time as the present impression. Innumerable recognitions of this kind take place every day; thus, in watching a theatrical performance, we have to recognise, by sight, the men from the women, the characteristics of the various dresses and scenery, the meanings of the various

gestures and attitudes, etc. By hearing, we have to recognise the meanings (ideas) associated with the combination of irregular sounds we call words; but not only that, to receive various ideas, according to the way the word is pronounced, whether with emphasis, emotion, or ironically. In the latter case, a very peculiar result is brought about, the word pronounced in that way at once conveying to the mind, even of an uneducated person, the very opposite to its real meaning.

Words and their accompanying expressions are so instantaneously recognised, that the process of memory concerned in the recognition is very generally overlooked.

B. *Laboured Recognition.*

There are two varieties of this: one in which at first there is no remembrance whatever, and the other where there is a partial remembrance.

Thus, we may have no knowledge whatever of having seen an individual before; and we may remember that we have seen him before, but not recollect where, or what his name is.

In the first case, no revival or association whatsoever has taken place with any previous impression; in the second case a partial association, in most cases with the more intensified portion of the impression belonging to a special memory. Thus, the man who can remember faces, but not names, recognises the individual, but does not remember his name; if he have the faculty of perception of relative position, he will also remember where he has seen him.

Let us take the first case: he probably walks on with the individual and talks, until suddenly some word,

thought, or action of his companion makes him recollect who he is, and now the present impression has become associated with the past one which is recalled.

I will now introduce the third law of remembrance into the process of recognition: the components of an impression cannot be revived, if that impression be always received as a whole; to be remembered as components, they must be perceived as components; thus, a man who has only learnt to write his name by imitation, and not by learning his letters, is not able to use the constituent letters; but he may be able to recognise these if they have been pointed out to him as separate and distinct parts of the word.

It is obvious that a man cannot recognise what he has never known; and it is equally certain that he will never recognise *as* a component what has never been perceived as a component, unless the whole impression has been very vividly perceived, or forms a close association with part of a special memory. Thus, in the examples already given, the persons to whom they were shown did not recognise the plane-tree leaf as a similar one to those on the trees which they were in the daily habit of seeing; though the others easily recognised a clock as a whole, they had not recognised a peculiarity in a component. Each time a previous impression is revived, the impression received at the present time and that received in the past become associated, and when the impression which is received at the present becomes revived in the future, then the associated ideas become revived with it, and so for all practical purposes the revival of this impression answers the same purpose as if its twenty component parts were revived. The practical bearing of this is well known in education;

thus, to use a common expression, a person is taught to 'use his eyes.' Note the difference between a botanist looking even casually at a flower and an individual having no knowledge of botany doing the same. He first sees a flower, its proper natural order, the number of sepals, petals, etc.; its name, both botanical and ordinary, at once occur to him. If he look at it carefully, then he will be able to detect any variation from the normal type, and any peculiarities about that particular species. The greater part of this at once occurs to him, in the same way as an ordinary individual recognises a horse. But with the second man—what does he see in the flower? A casual glance probably gives him no information whatsoever, and this is especially likely to be the case if he should not know the name of the flower. If he look intently at it, then he may notice its peculiarities of colour and form in a rough way. Here are two individuals, both looking at the same object, and with what different results. They both see the same flower, but if asked afterwards to describe what they had seen, how different would be the descriptions; in fact, they would hardly be recognised as being supposed to represent the same object.

The botanist, when first studying botany, had carefully learnt the various component parts of a flower; when observing a flower afterwards the consciousness of having learnt these component parts occurs to him, and then parts of the previous impressions which are revived and brought again before the mind, form component parts of the same impression with the flower; and when at a later date the impression of the flower is revived, those ideas are naturally revived with it.

The same occurs with language: the component

parts of a sentence are not noticed usually, but the whole sentence gives rise to certain ideas; but we are always able to notice the component parts if we wish to, by reviving other impressions.

Then, there is another variety of recognition. When the idea of some object, which is wanted, is in the mind of a person, and he is wishing to find the object by means of this idea, as in looking in a bookcase for a certain book, or searching for any other article, the process really consists of a mental comparison of impressions, and clearly shows how separate the perceiving portion of the brain is from the receptive portion. It will, therefore, be seen at once that, the two parts being separate, it by no means follows that because an article is *seen* it is *recognised.* This, we actually find to be the case. Who has not, when looking for a book, or something which has been temporarily lost, searched in every possible place without finding it, and a few days afterwards discovered it in a place where it *must* have been seen, and wondered how it could possibly have escaped his notice?

One of the best examples I know of this kind is one which must have occurred to every medical man when dispensing medicines. He is looking for a particular drug and cannot find it, and perhaps looks at every bottle in the dispensary without being able to see it. A few days afterwards he will find it in a position where he *must* have looked at it, as he knows that he examined every bottle on that particular shelf. I have known half a dozen students all looking for the same drug, and, at last, having to give it up in despair, and be shown next day what a prominent position it occupied. Here the impression of the name was not

sufficient to evoke the consciousness of its being the thing wanted; obviously the impressions had not become connected.

It is, again, well exemplified by the following common occurrence.

A man has just left two friends in a crowd; they have moved from the position previously occupied, and he has returned, and is looking for them. It is perfectly clear that the whole picture representing the crowd and surroundings will be focussed on his retinæ, and thence conveyed to the brain, where the process of finding his friends is really going on, his perceptive faculties searching, as it were, in this general view. At last, he recognises them; they may have been in a prominent position, and his eyes have wandered over them several times without seeing anything which revived the consciousness of their being his friends, the means of recognition being the colour of a dress, shape, general appearance, etc. He then feels puzzled to think why it was he did not at once see them. What has taken place is probably this: When looking into the crowd, the images, of his friends there, were not sufficiently strong to be able to bring any previous impression (such as the association of their particular forms with the ideas concerning them, as being his friends) before the consciousness, the two combined not reaching the necessary intensity. So he has to intensify the necessary portions of the impression of the crowd in some way. This he does by means of his perceptive faculties, as we know that the more intently an object is regarded, the more intense is the resulting impression; so he looks intently about him until he comes across them, and then recognises them.

Another good example of this association of impressions, is that of a man meeting an acquaintance whom he has not seen for some time. His friend recognises him, but he does not recognise the friend; but being anxious to conceal this fact, talks to him, with the hope of soon being able to recollect who he is. Now, it is clear that, granting that the friend had not changed much in the interval, there will be in this man's mind two disconnected impressions, at the least, of his friend. But whilst talking, some remark recalls the whole to his mind, who the apparent stranger is, and all about him: the remark has revived the previous impression, and the two have obviously become associated.

How different would be the recollection of the man in this case if he had walked off without recollecting his acquaintance. He would probably not know him again in a day's time; *now* he has firmly established in his mind who the other was, and is not likely to forget him when he again sees him. Obviously there is distinct difference between those cases in which recognition does not take place, and those in which it does; and this difference is exactly what we should expect to find from theoretical deduction, namely, that the impressions in the centre for sensory memory are separate until recognition takes place, and then they become directly associated, and the person is viewed in quite another light. Is this to be called unconscious cerebration? The fact of not at first recognising who our acquaintance is, but something in the conversation, his look, or manner, recalling the whole, is exactly similar to trying to recollect some name, and having it come to the mind at a later period without effort. In the case of recogni-

tion, the association, which brought back the name of the person spoken to, can usually be found (and so, in fact, can the impression in the other case, if it be looked for—*see* Unconscious Cerebration); and so the process is *not* unconscious, but simply due to direct or indirect revival; if direct, a similar sound, or contiguous impression, is usually the reviving medium; if indirect, some associated idea. The following is an illustration of this: I was once trying to remember the name Snell, and was not able to do so by an effort of the will. A few minutes afterwards I happened to make a hissing sound with my lips, and the name at once flashed into my mind; but I was able to trace the reviving impression, which was, in fact, the accidental hissing sound I made with my lips, recalling the letter S; and that was sufficient to revive the word; the process would have been indirect, if the hissing sound had brought to my mind the idea of a snake, and the sound of snake had revived Snell. The process was in no way unconscious; the result would have probably been the same if I had gone through the alphabet, except that the revival under those circumstances would have been indirect. Again, it is not uncommon for a person, after ineffectual efforts to recollect a name, to resort to a directory, or other list of names, with the knowledge that the required name is amongst them. For example, the trade of the person sought for is known, and the name *must* be one of perhaps a dozen. This list is carefully, but ineffectually, gone through, and several days afterwards the name flashes into the mind. The directory is again consulted, and the name found to be present. The explanation of this is similar to that of the cases given above, the impression of the name, as seen in the

directory, not being sufficiently intense to revive the previous impression. This is especially likely to occur with those persons whose faculty of form is weak, and so the special memory developed by the faculty will have comparatively slight intensity: the impression, which revived the name at a later date, belonging to another special memory, as a similar *sound* or a component of an impression, of which the name formed another component.

RECOLLECTION.

The distinction between remembrance and recollection has been already alluded to, and now will be further discussed. Recollection is a process in which there is an intervention of the mind, before an impression is brought before the consciousness. The revival, therefore, is indirect, an idea being present in the mind before an impression is revived. Thus, an artist wishes to make a sketch to represent a certain subject; he has, accordingly, these ideas in his mind, and by means of his faculty of form, in conjunction with these ideas, he is enabled to revive suitable impressions, moulding parts of each into a harmonious whole. Recollection is a voluntary process, remembrance an involuntary, the previous impressions being revived, and brought before the consciousness at the same time as the reviving impression. The process will be seen to be very similar in both cases, the centre of sensory memory occupying a midway position between the seat of the mind and the special senses. When the revival of an impression takes place through a stimulus being applied to one of the senses, the process is one of remembrance; when the revival takes place through an idea, present in

the mind, the process is one of recollection. This takes place in the absence of any external reviving object. If an individual wish to think about a subject, he must recall certain circumstances to his mind. These may at once occur to him, or only be revived with difficulty; so there is instantaneous and laboured recollection.

1. *Instantaneous Recollection.*

This is the recollection which is involved in the ordinary details of life, and varies in different individuals. The words used in ordinary speaking and writing belong to this class. Nothing is properly learnt until it comes under this head. Recollection depends upon the fact that the intensity of the impression to be revived is of such a degree as to reach the necessary sum of intensity to be brought before the consciousness, when stimulated by the ideas present in the mind. Each set of ideas and impressions is raised in intensity by special faculties, and when past impressions have great intensity, they are easily revived, even when the individual has a moderate-sized or small faculty. When a faculty is very large, feeble impressions, special to it, are revived, because the possessor is able to raise the intensity of the impression, present in his mind, very considerably. Comparatively few persons are able to mentally picture to themselves the surrounding objects, but those who are able to do so know how, by dwelling on certain portions of the impression, they are able to increase the intensity of the whole. Here again is an argument in favour of the view of single impressions: a person who is used to this mental picturing soon finds out that he must think of some definite impression; thus, an artist, wishing to

draw a likeness of an absent friend, would think of some definite time when he saw that friend.

2. *Laboured Recollection.*

This occurs when a man is asked some question, as the name of another person, and is not able to recollect, at once, but does so after a mental effort. As the necessary sum of intensity cannot be brought about, either from feebleness of the impression, or weakness of the special faculty, he tries to bring some additional faculty or impression to his support, and so be able, by a better stimulus, to revive the impression. In this case he wishes to get one of his other faculties to suggest the required name. If the name be part of some definite impression, and other parts of this impression be of greater intensity, then, by reviving these parts, the whole of the impression will probably be brought before the consciousness. I will give an example: a man with a large faculty of position wishes to recollect a certain conversation; he finds that he cannot do so when he is first told that such a conversation has occurred, so he tries to imagine himself back in the street or room where it took place, and succeeding in doing so, remembers the conversation as well. In the same way, a good musician would recollect the words of a song on account of their association with the tune, whereas a man with only a slight knowledge of music would remember the tune through the words.

It is on the third law of remembrance that education primarily depends, as the following examples will show, as well as illustrating the influence of the other two laws:

(i) *Baby Learning to Talk.*

A baby constantly hears the sound 'pa' repeated to it, and it soon becomes conscious of having heard the sound before, and after a while notices that the word 'pa' is always said, when a certain male individual presents himself, and as both of these impressions (the sight of its father, and the sound, 'pa') are received at the same time, they become component parts of one impression, and the constant revival of this impression makes both of its factors of sufficient intensity to be brought before the consciousness with a feeble stimulus, one factor at once reviving the other. Therefore, the sound 'pa' becomes associated, as it is called, with the father himself.

There is no inherent association between words and ideas; words are arbitrary sounds, which vary in different countries, and are chosen to represent certain ideas.

The baby, at a varying period, tries to imitate the sound, and after a number of trials, succeeds in doing so; the joy at having done so, and the attention paid to this impression, tend to intensify it in both the sensory and motor memories. It then repeats the newly-learnt sound, and applies it to its father. A permanent association has now been formed, and the natural tendency, which the component parts of an impression have to revive each other, is strengthened to such a degree that the slightest mention of one recalls the other.

(ii) *Learning Qualities of Objects.*

The various qualities of surrounding objects are learnt in the same way; thus, the child touches the

table and finds it cold and hard, tastes sugar and finds it sweet, and feels that the fire gives out heat. In each case the object brings its qualities before the mind every time, and so we have the conscious revival of previous impressions. It is when this is not done that we get 'disassociation.' Supposing we have learnt a new word: when we want to use this word, and think of it, the circumstances under which it was learnt, and the surroundings, will occur to the mind, as, for instance, in a speech or a dictionary. But we only want the word, not the rest of the impression, so we only revive the word, and suppress the remainder, by paying no attention to it; this being continually done, the contiguous associations of the word become so feeble as, at last, to cease to be revived at all.

(iii) *Process of Reading and Writing.*

The process of teaching a child its letters is as follows. A letter, say P, is pointed out, and the sound, 'pee,' said at the same time; then the sound 'pee' and the arbitrary form P become component parts of one impression. This impression, as a whole, is continually revived, until mentioning one part of the impression, either the sound or the form, at once brings the other component to the mind.

There is no primary association between the form P and the sound 'pee'; they vary in every country, and the particular shape of the letter to represent each articulate sound is purely arbitrary; thus the form M would equally well represent the sound 'pee,' and the form P, the sound 'em.'

The next part of the process is the combination of letters into syllables, thus P-E-N, PEN. Then the written

word PEN and the sound 'pen' become component parts of one impression, and other factors of this impression are the visual appearances and tactile sensations of a pen. These become associated in exactly the same way as the sound 'pee' and the letter P do; that is by forming component parts of one impression.

It is not necessary that an individual should know his letters in order to learn that the word 'PEN' stands for a certain indispensable article for writing. The advantage of his possessing this knowledge is this: when he sees the word PEN there is a conscious revival of the letters P-E-N, and so he knows that the *form* that he sees on the paper consists of the letters P-E-N. A man, not able to read and write, might look at a sheet of printed letters and have the word PEN pointed out to him as representing a pen; then, if his memory for form were good, he would recognise the word again, and the other component of the impression would occur to him, namely, the idea of a pen. He might learn several words in this way. I know several working men who write their names, having learnt them in this way, who otherwise possess no knowledge of reading or writing.

This is the way in which hieroglyphics have been deciphered; the researchers find out the ideas which some of the hieroglyphics represent, and then gradually piece together a whole.

Therefore, the difference between the man who understands how to read, and one who does not, is, that though the visual impressions may be similar, the educated man has the conscious revival of previous impressions at the same time, and so *understands* the meaning of the printing.

Let us continue the synthesis of the process of learning to read. Add another word to PEN, as THE PEN : another idea becomes associated with this impression, namely, not pens in general, but one in particular. Add another word, THE STEEL PEN ; this revives another idea. Extend this as, I PREFER WRITING WITH A STEEL PEN. This sentence conveys to the mind of a reader certain definite ideas, and these are associated with the sentence as a whole; the factors are revived as well, but are not generally noticed, as the mind only dwells upon the associated ideas.

Thus, it is easy to skim a book, as it is called; that is, look rapidly down a page, and gather, from the glance, ideas as to the contents of the page, and to read it more carefully if anything of importance be found. A well-educated man accustomed to extempore speaking is not compelled to gradually compose each sentence by a definite remembrance of words, but remembers whole clauses and sentences associated with the required ideas. He has in his memory a vast number of words and sentences, associated with the memory of ideas similar to those present in his mind, which revive them, together with their associated components, the words and sentences, and from these he makes his choice.

The reader should compare the above with the accounts given by Mozart and Zerah Colburn of their own minds, and he will hardly fail to be struck by the resemblance. First, to take the case of Mozart, he was able to compose without the aid of musical instruments, his remembrance of them and their peculiarities being so accurate. Now the musical notes correspond to the letters of words, and bear no more relation to the sounds than the forms do to the letters; the simple combinations

of notes correspond to the words themselves, and the more lengthy combinations to sentences, the whole piece corresponding to a speech. In the same way as an orator chooses words and sentences appropriate to his subject, so did Mozart, from previous impressions of music, build up his masterpieces, being able, after he had finished, to see the *whole* of the impressions he had constructed at one glance, as the orator can view his speech, and consider whether anything requires to be added. It is not necessary that either should be written down. Mozart could and often did play a piece without having committed it to paper, as the experienced orator can deliver his speech, or either could extemporize. The resemblance in the example of Zerah Colburn is still clearer, and explains how he was able to perceive the factors of a given number, for which no mathematical rules are laid down. The ideas of number must be first clearly distinguished from figures, with which they have no more *necessary* association than the written notes have with a tune as played on a piano: the process of association is exactly the same as that described for reading and writing. In order to more clearly understand these ideas of number, let the reader imagine a series of *single* irregular forms as representing the numbers of units when they cannot be represented by any multiple of the numbers already given; thus, one, two, and three may be represented by 1, 2, and 3, but $2+2$ represents four; five is a primary number, 5; but six can be represented by $3+3$ or $2+2+2$; this at once separates the odd from the even numbers. Continue the process, seventeen may be represented by a single form, eighteen by $2 \times 3 \times 3$, multiplication being an increased process of addition. Now if

numbers were learnt in this way the primary numbers would correspond to the letters of words. Anyone is able to give the factors of the number eighty-one, and if we consider this process, increased by the memory possessed by Bidder or Zerah Colburn, the whole will appear clear; thus the different factors at once occurred to Zerah Colburn, as the letters of a word occur to an ordinary person, that is to say, the previous impressions making up that number were revived. The multiplication-table constructed by Bidder, and simply remembered, reached a million.

On a careful consideration, it will be seen that, even with ordinary persons, the remembrance of the multiplication table depends upon the remembrance of the *idea* of so many units, and so simply depends upon a memory known to be true by experiment, in the same way as a person is able to pay attention to the ideas which a sentence conveys, without necessarily taking notice of the constituent words and letters *as components*.

It is often difficult to dwell upon the components of a sentence when we wish to, on account of the definite association of ideas with sentences: anyone who has corrected proofs, must have noticed how difficult it is to avoid leaving a certain number of printer's errors uncorrected, even when the whole attention is directed to the purpose of detecting them.

Let us consider the process of addition: when 6 is to be added to 8, the idea of 14 at once occurs to the mind, the elementary process of obtaining 14 by the gradual addition of 6 units having been surmounted. When we teach that 6 added to 8, make 14, we want to impress on the mind of the student the idea of 14

units. It could hardly be said that the process consists of the rapid addition of 6 units.

Then $6+8$ revives the consciousness of 14, when seen; and as the individual becomes more accustomed to adding up figures, $6+8+5$ becomes associated with the idea of 19; that is to say the idea of 19 at once occurs to the individual, on seeing these three figures, the stage of 14 having disappeared. Later on, $6+8+5+3$ becomes associated in the same way with the idea of 22, the stages of 14 and 19 having disappeared; and so on, until the individual can add up a column at a glance.

It is exactly the same with reading: first the letters have to be spelt out carefully; then the idea at once occurs on seeing a word; then ideas associated with a sentence at once occur on seeing it, the gradual process of associating the individual words being no longer necessary. Finally, the stage is reached when an individual can gather the ideas on a page at a glance.

The above is easily explained. When a 6 is seen first, the word six is said, and the idea of six units is conveyed to the mind at the same time; thus, they all form part of one impression. This being the case, when the figure is seen (and the first impression has been of sufficient intensity to be revived), the idea of six units and the word at once occur to the mind. Then, when it has been learnt that the sum of 6 and 8 is 14, the fact of seeing 6 and 8 in the form of addition, and the idea of 14 units, form part of one impression; and so when 6 and 8 are seen again in the addition form, the idea of 14 units is revived with it. In the same way $6+8+5$, and $6+8+5+3$, become associated with the ideas of 19 and 22 respectively.

It will be seen that if the memory be very accurate and retentive for numbers, there is scarcely any calculation which could not be performed.

Thought.

The processes of thought are intimately connected with those of remembrance. There are two ways in which a person may think: he may allow thoughts to occur to his mind spontaneously, or he may seek for them in certain directions. The first is the more common process, and takes place as follows:

A man is walking along a quiet lane, thinking of nothing in particular, when some object or slight incident *brings something to his mind*, as it is called; for instance, the shape of a tree reminds him of one that he has seen in a Welsh woodland. Then his ideas revert to this scene, and he remembers other particulars, the people he went with, their conversations, etc. Then his mind may wander on: he may think of various particulars regarding those people, and what has become of them, and then, that one was a lawyer; then he remembers that he had forgotten to see his own lawyer as he had intended to; then he reflects on the best course to adopt under those circumstances. Then other law details occur to him, and so on, until the starting-point of the train of thought is entirely lost; but it is often easy to trace the whole series back to the original idea, thinking first of the idea which suggested that present in the mind, then the one before, and so backwards. A whole conversation may often be remembered in this way. The part taken by each law of remembrance is easily seen, those impressions which have acquired the greatest intensity being those which

are most likely to occur to the mind. How common it is, when two persons have been talking, and then stopped for a few minutes, for the first one to recommence the conversation with a subject which the other also says he was thinking of, apparently quite unconnected with their previous conversation. The explanation of this is that the impression is an intense one, and requires a very slight stimulus to revive it. As it forms an important point in the knowledge of each, and both are liable to the same reviving impression, it is not at all surprising that the same idea should occur to both persons: for instance, a person may meet them who happens to be a mutual acquaintance, or an object is seen which suggests similar ideas to both persons.

A suggested impression may appear so vividly before the mind as to completely overpower a real impression. Thus, I was once travelling by railroad to Battersea Park, and firmly believed that I had passed Chelsea, and that the next station *was* Battersea Park. When the train reached Chelsea, I looked out of the carriage at the sign-board, and saw Battersea Park there, as I expected, and got out of the train, but soon noticed that I had alighted at the wrong station; I felt perfectly convinced that I had seen Battersea Park on the sign-board, and went back to look, of course only finding Chelsea. There was no mistake in the sense of one word being mistaken for another, for the words Battersea Park are not the least like the word Chelsea, and I looked directly at the sign-board, and *plainly* saw Battersea Park. Such is the probable origin of a good many ghosts.

An excellent method of proving how this revival of impressions will often have more influence on the mind

than the object really seen, is found in Wheatstone's pseudoscope. This instrument effects a reversal of the perspective of objects; thus, an intaglio has the appearance of a cameo, and *vice versâ*. Now, if the mind only had cognizance of the impression as elaborated by the sense of sight, all objects, when looked at through the pseudoscope, should appear converted in this way. But this will not take place if the converted form be not as familiar to the mind as the real form; that is, there should be impressions of the converted form in the centre for the sensory memory, ready to be called up by the impression really seen. When the interior of a mask is looked at through the pseudoscope, the image in relief is apparently seen; but if the outside of the mask be looked at in the same way, a considerable time is required before this conversion takes place; that is, until the impression of the object actually seen gradually overcomes the influence of that which is revived. No period of time, however protracted, is sufficient to make the face of another person, seen through the pseudoscope, appear like a mask.

The following, related by Dr. Tuke, shows in an admirable manner how similar impressions may be revived, and falsify the perceptions of a number of persons:

'During the conflagration at the Crystal Palace, in the winter of 1866–67, when the animals were destroyed by the fire, it was supposed that the chimpanzee had succeeded in escaping from his cage. Attracted to the roof with the expectation in full force, men saw the unhappy animal holding on to it, and writhing in agony to get astride one of the iron ribs. It need not be said that its struggles were watched by those below with

breathless suspense, and, as the newspapers informed us, "with sickening dread." But there was no animal whatever there; and all this feeling was thrown away upon a tattered piece of blind, so torn as to resemble to the eye of fancy the body, arms, and legs of an ape!'

That the pseudoscopic experiments are really due to the revival of previous impressions, and not to a perverted judgment, is proved by a comparison with other sensory impressions in which there is no previous one to revive; thus, if the index and middle fingers be crossed, and a marble placed between them so as to be in contact with both, it seems as if there were two marbles instead of one.

There is another point which has to be considered in the process of the direct revival of previous impressions, and it is this: the mind has no consciousness of this direct revival other than by a mental comparison of impressions, the comparison being made *after* the direct revival has taken place. This is the explanation of intuitive likes and dislikes, and intuitive judgments. It is very common to hear people say, 'first thoughts are best,' a correct explanation or judgment having come into the mind, but been abandoned after a process of reasoning. A very familiar instance of this kind is found in a person who is more practically than theoretically acquainted with a subject; thus, I know many persons who are able to say at once whether a sentence is or is not grammatically correct, and if not, the amendment required. This is due to a certain set of ideas becoming associated with certain forms of expression, according to the second law of remembrance, and when one component is revived, the other occurs to the mind. Such is the explanation of the way in which

certain persons form ideas of the character of others. This is especially found in judges and detectives, who are often able to say, on seeing a prisoner, whether he be innocent or guilty, and their conviction generally turns out to be correct. If asked why they had formed this opinion, they would be probably unable to say, the truth being that certain ideas, based on continual observation of guilty persons, had led to the association of certain peculiarities of person and demeanour with the idea of guilt. This method of judging forms the basis of the so-called common sense. In this way a person may very often give a correct opinion on a subject, but be quite unable to give his reasons for that opinion; and if made to give reasons, they will almost certainly be wrong. This will be again referred to, when speaking of the so-called unconscious cerebration.

CHAPTER VIII

THE DIRECT CONNECTION BETWEEN THE MOTOR AND SENSORY MEMORIES

THERE is a tendency for the nervous force from an impression to pass to all parts of the brain ; it only brings a past impression in the sensory memory before the consciousness, when the sum of the impressions reaches the necessary degree of intensity. As an impression is only increased in intensity by a conscious revival, and associations are only formed under similar circumstances, unless an impression be actually revived, this tendency to revival, if entirely unfelt, produces no increase of intensity. The transient character of dreams is due to the consciousness being at such a low ebb when they are received.

When a co-ordinate action has been learnt, the motor memory has reached a fair degree of intensity, and so the nerve-force passes directly from the impression in the sensory memory centre to that in the motor memory centre, and tends to bring about the movement reflexly, that is to say, the motor and sensory memories become directly connected beneath the plane of consciousness, the intervention and controlling influence of the mind becoming less and less required, and the movement becomes more and more truly reflex. When the movement is right-sided, only one set of ganglia is

employed. As this movement is repeated, so does this direct connection become more and more complete, a sensory stimulus at once exciting the required movement. In other cases the individual, wishing to write certain words, leaves it to the motor memory to do so. There is nearly always a certain modifying action of the cerebrum, until after many years of repeated movement this has become practically nil, as in the case of the reporter who could fall asleep and still go on reporting.

As both the sensory and motor memories are beneath the plane of consciousness, the mind has no cognizance of the direct combination or the movements produced by it, other than by the information afforded by fresh sensory impressions.

The faculties having performed their functions of establishing the sensory and motor memories of certain impressions, have, when these have reached a certain intensity, become superfluous, and may be usefully employed on other subjects: this the 'direct connection' allows them to be.

How contiguous impressions become associated has been discussed, and how the revival of impressions takes place has also been noticed.

I will first describe the direct association of the sensory and motor memories in ordinary shorthand writing, because this is a subject which is learnt at a much later period than ordinary writing, and, therefore, the reader will be more easily able to compare the following account with his own experience. The same applies to ordinary writing, which is described on page 164, where the direct connection is not mentioned, in order to avoid confusion, but will be described here.

The first necessary step in learning to write short-

hand is to learn the alphabet; that is, that a straight line slanting downwards from the left to the right is P, a perpendicular stroke T, a horizontal stroke K, and so on. Then the shorthand character, the longhand character, and the corresponding sound become component parts of one impression, and are represented by two movements, one designating the longhand letter the other the shorthand letter, but they are recognised as distinct, though both representing the same sound.

After a short period of practice, the student is able to remember the forms he should make to represent the articulate sounds. Every repetition of the movement increases the facility with which it is made, and the intensity of the motor memory.

As this intensity grows, less and less attention need be paid to the movement, until a suggested letter is written at once.

There are two ways in which words may be written:

1. From dictation or copying from a book.

2. To express ideas with, or to write down some words previously in the mind.

In the first class of cases the part which the direct connection plays is obvious; thus, a man, who is accustomed to write from dictation, will write down the words and be thinking of something entirely different at the same time, and be, if asked, quite unable to say what it is that he has written down, only recognising that it is his work by the handwriting. What has taken place?

The sound of the speaker's voice has revived other impressions; these impressions are associated with, and have been followed by, the movements necessary for the

execution of certain forms, and so the pen being on the paper, these forms are written, the execution of the words being left entirely to the motor memory.

It is the same with copying from a printed book; the memory of similar printed words is associated with that of the corresponding spoken words, and these are associated with the motor memory necessary for the formation of written letters.

It will be seen from the above that dictation and copying can be carried out mechanically, and involve very little mental labour, as do all the processes of revival and performance of movements when executed by the basal ganglia; when the cerebral hemispheres are used there is much greater effort required; thus, let the reader compare the difference, when he is mentally tired, between simply copying some writing and reconstructing the sentences and putting them in his own words.

Notice the great difference there is between writing a word which is well known and has been *written* many times previously, and one which, however well known, we have not been accustomed to write. In the first case the word will be written easily and without any thought, whilst in the latter the word is written slowly and with considerable trouble, and very likely a mistake will be made in the spelling.

How far this machinery extends will depend upon the ability and the amount of practice the individual has had.

A boy learns that the form B represents the sound bee; in the same way he learns that the forms L, A, C, K, represent the sounds el, ay, see, kay, respectively.

Then he learns that the whole word, BLACK, repre-

sents the sound blâk; that is, the two, the sound and the form, form component parts of one impression.

Now, if he wish to write the word, he must first have a consciousness of its constituent letters; that is, be able to spell correctly, then have a sensory memory as to know how those letters should be formed, and a motor memory so that the right muscles are employed.

The revival of a previous sensory impression is usually brought about directly; that is, the sight of the word brings the necessary constituent writing characters to the mind, at the time of the reception of the impression, or the revival may be indirect by the cerebrum, as when we wish to spell a word we have just heard.

The sensory memory remembers the attempts which have been previously made, and by the aid of them corrects the movements, until an accurate co-ordination of the muscles is obtained; then by degrees the motor memory acquires such an intensity and accuracy that the slightest impulse from the cerebrum brings about the requisite movements.

It will be seen that when the sensory and motor memories have attained this degree of perfection, the cerebrum which brought it about has become clearly unnecessary, and can usefully have some other employment, and this we find to be the case.

For instance, when an individual has learnt to write the letter B with facility, the sensory memory of the letter has become directly associated with the motor memory for the production of the written form; that is the sound 'bee,' or the sight or thought of the letter, is sufficient to bring about the execution of the necessary movements without any interference from the cerebrum.

In the same way, all the other letters of the alphabet become associated with their respective movements.

Then, as explained previously, the whole word becomes associated with its constituent letters, and as these individual letters have become associated with the respective movements to make the representative forms, the formation of the written word is easily explained.

We can analyse the process of writing a sentence in the same way: the sentence revives the previous impressions of its component parts; these component words revive the impressions of their constituent letters; these are associated with the motor memory for the necessary movements, and so the sentence is written. If the constituent letters have not been associated correctly with the component words of the sentence, bad spelling is the result. There is nothing in the essential order of things that the sound 'flem' should be written 'phlegm'; to be written correctly the word and its constituent letters must have been received as one impression previously, and at the same time acquired the requisite intensity.

The process is similar in the case of a person who is writing an original treatise. He obtains ideas from previous impressions, and then dwells upon the subject and expands it. The next step is to put these ideas into words; to do so he must have a suitable stock of words, that is, he must be able to revive easily impressions of words suitable to express the ideas he has in his mind.

If he be or be not writing at the time, the impressions of his composition will be registered in the optic thalami in the usual manner. But if he be writing as the thoughts occur to him, then the direct track will be

used. As a word is found suitable to the occasion, its constituent letters will be revived, and the word be written.

Whenever the cerebrum is used, there is a sense of distinct effort, which is very marked in comparison to the easy working of the direct combination of the memories. This is particularly noticeable when we wish to make some alteration in our writing. The easy flow of our ordinary caligraphy is interrupted. How difficult it is, at first, to remember to cross the 't's' when we have been accustomed to leave them uncrossed. At first, even if the whole attention be devoted to performing this one simple act, how often a 't' will be left uncrossed, especially if the writing be at all rapid.

After some practice, the change becomes less difficult; the motor memory and corresponding associations become established, and gradually increase in intensity, until an uncrossed 't' is never written; that is, the motor memory of the uncrossed 't's' gradually gets feebler, whilst that of the crossed 't's' is increasing in intensity; and as nervous force always passes in the direction of the greatest intensity, the uncrossed 't's' are, at last, never written.

The vast importance of this association of memories in education must be apparent; thus, nothing in which movement is a component is considered to be thoroughly learnt until a perfect association has been formed, and the movement can be performed without conscious knowledge of voluntary action.

The process of learning to write shorthand is exactly similar to that of writing longhand, but it shows more completely the formation of the direct association.

First, the shorthand alphabet is learnt in the above manner, the respective sounds and forms of the longhand letters become associated with the sensory impressions of the shorthand letters, and the muscular movements necessary to produce them.

If shorthand consisted of a mere combination of these simple curves and strokes, the process would be exactly the same as in learning longhand, but it does *not;* there are a number of arbitrary forms to be learnt; thus, instead of 'pr' being represented by the combination of the two forms representing the 'p' and 'r,' a form, consisting of a 'p,' with a hook on the left-hand upper corner to represent the 'r,' is used.

Then there are absolutely unconnected, arbitrary forms, called grammalogues, to represent whole words, and even phrases, which are of very common occurrence, as a small circle for the word 'is,' and a large circle 'is as.' In addition to this there are various rules for facilitating the execution of various words, and shortening them in every possible way.

In cases where the words are represented by arbitrary forms, they will have to be learnt in exactly the same way as the single letters; only, instead of a single letter, the arbitrary form will be revived, and become associated with the requisite movement for producing it. So that when a word is seen or heard, the movement follows mechanically, as it is called.

The following occurs when the student is learning the rules for the division and combination of letters.

First, the rule has to be known and carefully applied, a process requiring care and attention; and any lapse of the attention at once causes mistakes to be made,

the primitive forms, and not the shorter combinations, being written. In this stage the rule is carried in the mind, and applied whenever necessary.

In the next stage the process becomes easier; the rule has not to be borne in mind at the outstart, but with careful attention is revived by seeing words adapted to it, which are written accordingly.

Less and less attention is required until the third stage is reached, then each word has become associated with its proper stenographic representative, and phrases with the words.

The practical example of the last stage is found in old reporters, many of whom are able to think of an entirely different subject when occupied in reporting a not too difficult speech; and cases are related of reporters falling asleep, and still going on taking down the speech. In cases where the reporter has been thinking of another subject, he only recognises the work as his own by the handwriting, and, of course, has no idea of the substance, the impression he has received being of far too feeble intensity on account of the slight amount of attention paid to it.

I will now mention some of the other effects of the direct association of the memories. When a man's writing has been 'formed,' as it is called—that is, when there is very little, if any, interference from the cerebrum, the process being left to the motor memory—the similarity of corresponding letters is most striking. A word is written in exactly the same way for years; the same mistakes are made; the curves are made in the same places, and slight slips, which have been previously made, are extremely likely to occur again. This we should expect with definite motor and sensory memories,

but it would be a practical impossibility if each act were the result of a definite cerebral action; exaltation or depression of the faculties gives rise to slightly different results, and other modifying influences cause various alterations in the style, but they do not interfere with that uniformity, the slightest deviation from which is apparent to the eye of a banker.

In learning shorthand, this is especially well exemplified; thus, I used often to find that when I was reporting a lecture without paying much attention to the formation of the stenographic characters, I used combinations which I had for a long time abandoned for better ones, and noticed them at once on reading over the notes.

It must be within the range of everyone's experience to detect some mistake in his writing or spelling, and wish to correct it, but find that directly his attention wanders, the mistake is made, and he has some considerable trouble in breaking himself of the habit—that is, in establishing a new motor memory of greater intensity than the old one.

It is exactly the same with other movements, as dancing, playing musical instruments, working the electric telegraph, reading aloud, or reciting.

The perfection of the direct combination is found when the performer is able to go to sleep, and the movement still continues. Numerous examples could be given; thus, cases are related of cavalry soldiers, who, after a long day's ride, have become so tired as to fall asleep on the horse's back, but have still ridden on exactly the same.

Musicians sometimes fall asleep whilst playing the piano, and continue in perfect time until they come to

a full stop at the end of the piece and awake, or start a fresh tune.

The following is a good example of the very complete way in which actions, requiring at first the greatest effort, may become entirely automatic. It was sent by a clergyman to Dr. Carpenter, and I give it in his own words:

'When I was a student at the Dublin University, I was at an evening party, at which a lady was asked to play for dancing. Unfortunately she had taken far too much for supper, and was, in fact, after she had begun to play, so drunk as to be totally unable to rise off the stool. I was standing near the piano, and saw her eyes close, her head fall forward, and give every manifestation of sleep, except snore aloud. But her playing went on in perfect time, and, in fact, the difficulty was *to make her stop*; for when she was shaken out of sleep, it was evidently her intention to go on all night. To set her going again, it was only necessary to set her hands on the keys, and she would begin a new quadrille, soon relapsing into sleep, and yet continuing to play well.'

The following case illustrates the process with regard to reading aloud:

A young lady about seventeen used to occupy a large part of her time reading to her grandfather, sometimes for three or four hours at a time. The subject-matter consisted of leaders from the daily papers, history and biographies, subjects of not the slightest interest to her; she soon found that she could read perfectly easily without paying the slightest attention to the book she was reading, carrying on an entirely separate train of thought, and never having

the slightest recollection or any knowledge of the subject she had been reading about.

Occasionally, when tired, she would fall asleep, but still go on reading in the same mechanical manner, and when she awoke, would find that she had gone over some considerable ground in the interval of unconsciousness.

The next case illustrates the performance of still more complicated movements.

An actor, meeting some friends one afternoon, drank to such an extent that his companions had to take him home and leave him in his rooms.

As he did not appear at the theatre, and the time for the performance was rapidly approaching, the manager sent two men to find out the cause of his absence. The men went to his lodging and found him lying in the grate 'dead drunk'; they immediately seized him, one on each side, and walked him off to the theatre. When it was his turn to act he was pushed on to the stage and staggered, but the moment he was addressed by the other performer he was apparently sobered, and went through his part as usual, without the slightest hitch. He had to be carried home again, and could hardly be got to believe it, when he was told next morning that he had been to the theatre.

The above is an exceptionally good illustration, as the cerebral functions seem to have been temporarily abrogated. It shows that whereas ordinary movements, depending upon inclination, and requiring a certain amount of cerebral action, if only to make up the mind as to the course to be pursued, were entirely abolished, directly he received the accustomed reviving impressions in the shape of his brother-actor's voice, the previous

impressions and associations were revived, and the requisite movements brought about. Here a large number of movements were required, as voice, action, and expression, but these, through repetition, were entirely remembered by the sensory and motor memories, no true action of the mind being required; if it had been he would almost certainly have broken down.

The following is an excellent example of the mechanical working of the direct combination of the memories.

Mr. Fawcett, the late Postmaster-General, once delivered a speech in Exeter, in which he used the word 'children' a great number of times. The telegraphist, wiring the speech to the central office, when half way through, became tired of using the word 'children,' and so abbreviated it into 'kids,' thinking, of course, that his correspondent would substitute the correct word. But next morning the 'kids' appeared throughout half Mr. Fawcett's serious speech in the *Times*.

The mind had not been brought to bear on the sensory impressions, and so it was left entirely unnoticed by any of those through whose hands it had gone. (See *Times*, 20th April, 1876.)

What is called 'absence of mind' is really more psychologically true than people generally suppose, as in these cases actions are brought about by the direct connection without any interference from and scarcely any cognizance of the mind.

Mr. Archer relates the following of Miss Mary Anderson, in a paper on the 'Anatomy of Acting,' in *Longman's Magazine:*

'After playing the fourth act of "Romeo and Juliet"

one night, Miss Anderson's maid began to unfasten her dress, in order to put on the white draperies of the tomb scene. "Don't do that," said the actress. "I have to play the potion scene yet," and it took some time to convince her that she had not only just played it, but had played (as her comrades assured her, and as the applause of the audience showed) with unusual effect!'

Very similar is the common occurrence of a man who has locked up the house and gone to bed, but still feels uncertain as to whether he has bolted the door or not.

In these cases the sensory impressions caused by the *performance* of the action are only received feebly, the intensity of the permanent impression having direct relation to the consciousness with which it is received, and when there is very slight consciousness that the action is being performed (the mind being employed on other matters), the intensity of the impression is correspondingly slight, hence the difficulty in recollection which is found, it being almost impossible to revive such a feeble impression, even though it has been received at so recent a period.

It is important to notice that a strong stimulus to the general memory may produce a result in exact opposition to that intended. Thus, many persons will have noticed that when writing down something, the meaning of which would be very considerably altered by a change in a letter or word, and they have taken particular care *not* to make this mistake, they will very often find, on reading over their script, that they have made the very mistake which they were anxious to avoid. The idea of the word to be avoided, being

uppermost in the mind, has revived a similar sensory impression, and the motor memory in connection with it brings about the movements necessary in the usual way.

It will be noticed that the impression, 'I must *not* say "How stout you are getting,"' differs very little from the impression, 'I must say, "How stout you are getting."' The little word 'not' has not the same importance in the formation of an impression as it has practically, and nervous people find this out to their cost.

I have come across a curious confirmation of the above. Many persons when sending a telegram content themselves with using a simple affirmative or negative; now it is found that a certain percentage of these become changed, a 'yes' becoming 'no,' and a 'no' becoming 'yes,' the telegraph clerk having in his mind the importance of not sending an incorrect message, the idea present in his mind revives a previous sensory impression and its associated motor memory. Now a person has no knowledge of the movement which is being performed when the action is brought about by the direct connection, except as a fresh sensory impression, as by *seeing* that he had written the word wrongly, which he could not do when the word was sent by telegraph.

There is another way in which the direct combination often brings about a result at variance with the desire of the person writing; thus, supposing a man has been accustomed to write two words in succession continually, as the Christian and surnames of his signature, he will be extremely likely, unless particular attention be paid, to write the surname as well, if he have to write the Christian name for any purpose.

This direct combination of the memories may be applied to explain somnambulism, which consists really in the working out of an impression, and this is often done very accurately, there being no interference from the mind.

Much light is thrown on mental physiology by the examination of errors, as 'slips of the tongue' and slips in writing, and considerable confirmation of the above views is afforded by them; thus it is easy to understand how an intense becomes substituted for a feeble component, as 'glad' for 'sorry' in a letter of condolence. Another common error is to insert in a letter a word or two of a conversation occurring in the neighbourhood of the writer, which bears no relation to the subject of the epistle. The explanation is obvious. It will be noticed that when a movement, brought about by the direct connection, follows a sensory impulse, there is less tendency for the previous impressions to be brought before the mind than when this is not the case, and the more completely reflex these movements become, the less cognizance the mind has of the exciting impressions, and the impressions excited, the nerve force at last travelling from the sensory to the motor memory entirely below the plane of consciousness.

One of the most extraordinary cases of this kind that I know of, is that of a lady who accepted a proposal of marriage when she intended to refuse it, simply through the addition of one or two small words to her letter. She was so ashamed of having made the mistake that she never undeceived the man, and actually married him!

When the direct connection acquires great intensity the movement will in many cases be brought about on

application of the usual stimulus, when in direct opposition to the will of the person acted on; thus, I know a medical practitioner who stopped a fight, in which a drunken soldier was taking part, by giving the word of command; the man instantly assumed the attitude of attention.

Practical jokers are aware of this tendency, and there is a story told which is probable enough, though I cannot vouch for the truth of it, of a soldier who was carrying his dinner across a yard, when some person called out, 'Attention!' with the result that the soldier assumed that attitude, and dropped his dinner into the gutter.

A sailor who has been accustomed to rise in the morning at the call of a bugle, will be wide awake and out of bed in a minute on hearing this call, years after he has retired from the navy.

CHAPTER IX

MEMORY IN THE LOWER ANIMALS

THIS chapter has been written not to record any marvellous instances of the intelligence of animals, illustrations of which are to be found at every performing-dog show, but to show how, like men, animals differ in character, their faculties, and special memories, and to give an outline of these, with appropriate illustrations. Corresponding instances will probably be found in the experience of most people.

Anyone who has had much to do with animals must have noticed that in many respects they have extremely accurate memories.

The general memory seems to be exactly the same in animals as in men, and special memories are developed in the same way, so that a dog will have a memory in accordance with the faculties he possesses.

With regard to the general sensory memory, an animal has usually a good remembrance of its surroundings, the whole impression being recollected, as in man, by means of the special memories. If you throw out some crumbs to the sparrows one day, they are very likely to come the next.

All animals must have good sensory memories, or they would lose their way, and not get back to their homes and lairs, as they are not able to find their way

by the names of streets, etc. In the chapter on Sensory Memory, I have already drawn attention to the fact, that it is only by means of the senses that we gain our information of the external world—a congenitally blind man is quite unable to comprehend the nature of sight, or a congenitally deaf man, hearing. Now it is perfectly certain that many animals possess faculties in a much greater degree than man, as in the case of a bloodhound who is able to trace the scent of a man across a crowded market-place. The sense of smell is much more accurate in savages than it is in civilised races, in whom it is comparatively unimportant. Let us suppose, for example, that there were another race of beings, higher in the scale of development than men but destitute of the sense of smell; these beings would not be able to comprehend that bodies should have properties which could not be recognised by the senses they possessed, especially by beings inferior to themselves in the developmental scale: as it is, a dog smells an object which to us is inodorous and is able to recognise it, and have ideas regarding its properties. Then, supposing man did not possess the sense of smell, he would be unable to understand how a dog could find out where a rat was without seeing or hearing it; and so it would be put down to instinct, as many explainable phenomena are. 'Instinct' is a most unsatisfactory term, and can only be used, like 'functional,' as a cover for ignorance. It seems to me that it is extremely probable that the lower members of the animal kingdom, if they do not possess senses essentially distinct from ours, have them modified to such a degree that this is practically the case. This is rendered probable both by comparative physiology and observation. Thus, if we

find such a gigantic difference between the senses of smell and sight in man, animals, and birds respectively, when their anatomy is so similar, it seems hardly probable that the senses are the same in insects, whose anatomical structure is so different. I cannot conceive how any one, who has at all studied the habits of insects, can say that they are simply living in accordance with a mechanism which has been devised for them, without any modification produced by themselves, that is, like well-constructed clockwork machines. I am perfectly sure, and those who have studied the habits of bees and ants will agree with me, that insects gain by experience and are able to communicate with one another. A communication might be made through any of the senses, especially if one were modified for the purpose.

Examples of motor memory are found in performing dogs, such as that required for walking about on the hind-legs, giving the paw, etc., besides the ordinary muscular movements required in progression.

The special memories of animals are such as are particularly required by them in the acquisition of food.

The faculty of locality is especially needed by animals, and here we have very good examples of its true function, namely, that of being able to perceive accurately the relative positions of objects. It is absolutely necessary for animals, or they would become lost in the winding forest, and not be able to make their way back again to their mates and young ones.

Instances of the special memory developed by this faculty are common enough, such as cats or dogs having been taken to a considerable distance, often by train, and yet finding their way home again.

Swallows find their way back to their old nests year

after year. Everyone knows how pigeons will fly back home again, at one time being made letter-carriers on this account.

The following are some good illustrations which have come under my own notice:

I have ridden on a very intelligent mare, who was accustomed to going through bridle gates; when coming to a gate she would always go the latch end, whether in the daylight or dusk. There is no definite rule for placing the latches, so it is by no means an easy thing to remember, when there are a number of gates to pass through. She thoroughly understood the use of the latch, and when it was pulled back, if the gate opened forwards, would push the gate right open by a series of movements with her nose.

Once I wished to pass through a pathway guarded by an iron gate, which had no latch, but was kept in position by its weight. She had not been this way before, and first carefully examined one side, and found no latch; then moved over to the other side and found no latch there either, and so drew back puzzled.

This shows that the mare not only remembered the latch, but knew its use, and missed it on not finding it on the iron gate.

A horse having been driven in the night to a house at some distance, in a rather out of the way spot, surprised its owner by suddenly stopping there a few weeks later; he was at a loss at first to understand why it should do so.

There are numerous well-authenticated cases of dogs finding their way home again, when stolen or lost, from considerable distances.

The faculty of time is often very well developed in dogs; thus, a dog belonging to a master who is accustomed to come home from the city at a certain hour, will often sit on the mat waiting for him, or go to some place where he can watch for him at the expected time.

A dog will remember the correct days if he be taken out for a walk regularly on certain days and not others.

The faculty of smell is more developed in most animals than it is in man.

The best example of a special memory developed by the faculty for the perception of odours is found in bloodhounds, who are able to track a criminal down after having been allowed to smell some article of clothing belonging to him; they are able to follow the scent even across a crowded market-place, only becoming baffled by a stream of running water.

They have been able, from the remembrance of the impressions received from the article smelt, to discriminate between odours, when to us no odours are perceptible.

The following are good examples of a special memory in dogs, the third showing a species of reasoning.

A gentleman went to visit a friend, and the dog ran out and barked at him; he gave it two or three cuts with his cane, and then went away. He did not revisit the house for eighteen months, but when he did the dog did not again bark at him, but waited till he reached the house, and then seized him by the calf of the leg. The dog had never previously bitten anyone, neither has it bitten anyone since, and there

appeared no reason, at the time, why he should have bitten this man.

A Pomeranian dog was fond of going to the station, so his master asked one of the porters to give it a good whipping, to prevent it from doing so. It never forgot this, and ever afterwards, whenever it met the porter, growled and barked at him.

This dog, though very fond of his master, would growl very fiercely at him if he pretended to strike his wife.

A Newfoundland dog, very much attached to his master, always used to wait on a wall between the garden and the road, and look out for his first appearance. One day, whilst sitting there, a boy came up, and, picking up a handful of stones, threw one at the dog. The dog immediately got down off the wall into the garden, and appeared to take no further notice. Next day, however, the servants noticed that instead of facing the garden, as he usually did, he faced the road. On the boy's making his appearance, he jumped down into the road and barred his progress, and would not allow him to pass, growling fiercely if he attempted to do so. The boy had, accordingly, to go right back and round another way. The dog acted in a similar manner for five or six days, and then allowed the boy to pass as usual, taking no further notice.

The following is an unusual faculty for an animal:

A dog was found to possess a remarkable liking for music, but howled dismally if wrong notes were played, so being rather an inconvenience, when inefficient performers came to the house; this faculty was turned to account by putting the dog in the room whilst the children were practising.

With regard to the memory for words:

The various dogs of a pack know their own names, and many dogs learn to understand the meanings of a large number of words, even when spoken in the ordinary tone of voice.

Besides the above-named faculties, examples might be given of nearly every faculty already named, in a varying degree; the chief difference between animals and men consists in the fact that the latter have more moral and reasoning power, and more power of controlling external influences, but the above are sufficient to show that the faculties and the accompanying special memories differ in animals as they do in man; there are clever dogs and stupid dogs, brave dogs and cowardly dogs, brisk dogs and lazy dogs.

It will be noticed that animals have to rely on their memories, when man has devised means to avoid doing so. Animals have to rely on their memories for time and locality, not having timepieces, and not being able to use directories. An animal has to rely on its own experience, or upon that which can be directly communicated to it by another animal; man is able to consult books, and to consult much more efficiently with his fellow-creatures by means of language. It is this means of communication which raises him so considerably above the lower animals; a very intelligent animal is not able to benefit its race, whilst an able man is able to not only benefit his contemporaries, but to leave a legacy to those who follow after him.

CHAPTER X

THE VARIATIONS OF MEMORY AT DIFFERENT PERIODS OF LIFE

GREAT difference exists in the memory at different periods of life; the subject will be considered under the following heads:

a. Sensory memory.

b. Motor memory.

c. The development of the various faculties and their predominance at different periods of life, and the special memories developed by them.

A young child has usually an enormous capacity for acquiring and recollecting impressions, and it is necessary that it should be so; if it were not, and the same difficulty found in remembering unconnected impressions as in after-life, the length of the period of childhood would be greatly increased.

What is the explanation of this? I have already shown that every impression received during an individual lifetime is retained, whether it is received in youth, childhood, or old age; and so it is, for if it were not, the old man would forget the first part of a long sentence before he had heard the remainder, and have no recollection of what he had done or whom he had seen the day before, whether he had had his dinner, etc. This is not the normal state, though it does occur; but then, if

not pathological, is only a greatly diminished degree of the previous state. What then is the difference? It is a difference in the psychical intensity of the impression, and the facility with which it is revived. In childhood the nervous force, like the other forces of the body, is abundant, and so impressions receive a greater primary intensity; and, besides, weaker impressions are more easily revived, because, there being an excess of nerve-force, the necessary intensity is more easily reached. In short, the child is in an almost similar position to an older person with a larger faculty, the difference being that in the latter case there is more persistence of action, a child becoming more easily fatigued. Variations in intensity will explain the difference in the acquisition of ordinary impressions by the same individual at different ages with regard to most of the faculties.

Nervous force being abundant, there is desire for knowledge, and impressions are stored up to be of use at a later period.

Children would take a much greater interest in their studies, than they usually do, if these were made to appeal to their faculties more directly; thus, a bare multiplication table only appeals to the numerical faculty in the most indirect manner. The whole could be much more efficiently taught with the aid of marbles, which would give rise to definite ideas of number.

It is at this age that all the various impressions necessary for a knowledge of the outside world, and for the performance of actions, are acquired.

Most children can very easily learn by heart without the least understanding what it is they are learning.

Then from childhood upwards there is a gradual

diminution in the intensity of the general impressions; the rapidity with which the intensity diminishes varies with individuals.

The motor memory, like the sensory, easily retains impressions; combinations of movements are learnt with greater ease when young than at a later period; actions learnt at this period are rarely forgotten. Habits acquired at an early age are only broken with difficulty at an after period. The formation of associations takes place with especial readiness during childhood, and those which are formed at this period have an influence over the remainder of the life. The acquirement of language forms an important part of a child's mental development, the ideas which can be communicated by its means greatly preponderating over those which can be conveyed in any other way, as by signs and by gestures. The communication of thoughts from one to another, by means of language, allows of a development which could not be otherwise obtained, thus placing man immeasurably in front of animals. With regard to the special memories, they vary through life, and with individuals; the following faculties are mostly developed at particular ages.

The faculty of amativeness is scarcely developed at all before puberty, boys usually preferring the society of their own sex.

In childhood and youth the perceptive, acquiring and emotional faculties are those most used; in adult age the reasoning, constructing, and moral faculties predominate.

Later still, only those faculties which have acquired by use a special predominance have much influence over the mind.

A great deal of the want of memory which is complained of is more apparent than real, and depends upon the same causes as the special memories. Thus, if a man will not take the trouble to try to learn the subject which he ought to study, it is hardly fair to complain of his memory. Many persons who use their memories considerably, say that it improves with age instead of diminishing. Then there is the change in desire and interest; the child will remember one thing, whilst the adult will remember another; the subject which interested the child the adult may scarcely look at, and so can hardly be expected to remember anything concerning it.

As old age approaches, a gradual weakening of all the mental powers is seen; but whilst events and circumstances happening at that period are scarcely remembered from day to day, those of childhood are recollected easily, their intensity having by the process of time become so great as to require only a slight amount of nervous force to revive them.

CHAPTER XI

SOME ANOMALOUS CONDITIONS IN WHICH MEMORY PLAYS AN IMPORTANT PART

THE present chapter is devoted to the consideration of a number of conditions in which memory plays an important part.

With regard to the so-called 'unconscious cerebration,' the previous chapters will show that such an action of the brain is impossible. I do not find the slightest evidence of 'unconscious cerebration.' All the examples brought forward in support of it are capable of being explained in a far more satisfactory manner, in another way, and, besides, there is direct evidence against such a theory.

The examples which are said to prove that unconscious cerebration exists, are chiefly cases where an endeavour has been made to recollect some name, event, or circumstance which has been forgotten, and the individual, after vainly endeavouring to recollect it, gives it up, and perhaps forgets all about the circumstance. A day, week, or other period of time elapses, and the name or circumstance flashes upon the consciousness, when perhaps the individual is thinking of an entirely different subject.

Other examples, which are said to be instances of unconscious cerebration, are those in which an author

wishing to write upon a subject, gathers all the information he can, and then rests for a while, allowing his brain to 'unconsciously cerebrate,' and then, after a certain period, he feels 'inspired' and that the subject has 'come' to him, so he sits down and writes.

Other classes of cases are, sudden remembrance after sleep or during sleep, as in the case of a man who worked out a problem and put it in his desk during his *sleep* (?).

Unfortunately, those authors who are agreed that the brain does 'unconsciously cerebrate' are not unanimous as to the cases which should be said to belong to this class.

The first class of cases is easily explained. The point required is, in most cases, simply the revival of a previous impression ; no ordinary process of recollection has been sufficient, and so the point to be remembered is apparently forgotten, but in a few days, whilst thinking of something else, the name flashes into the mind, some idea present in the mind or some external object having revived the impression ; and if we carefully analyse the revival, we shall see that this is the case, and be able to find out the reviving impression. With regard to the sudden solving of problems which have caused us considerable difficulty, only resulting in failure, everyone knows that in attempting to work out a problem, many will at once solve it and others labour for hours in vain, whilst in other cases the people who failed in instantly solving the *first* problem may succeed with the *second*, and *vice versâ*. Many people even go so far as to say that, if they do not guess or discover the solution of a problem at once, it is useless for them

to try further. So that the direct impression which the object in hand makes on the mind has considerable influence. The view that I think explains this is, that either some of the faculties of the mind have greater predominance than others at that particular time, making up a state which is particularly unfavourable to the revival of the required impression, increased efforts only exhausting the brain without success; or impressions are directly revived, which lead the student to suppose that the problem should be worked out in some particular way, whereas, perhaps, an entirely different method should have been employed.

At another period, the mind may be in a stronger condition, and in one more suited for the revival of the impression, and so the mental operation is performed with such rapidity as to appear instantaneous. Once when walking, thinking over this subject, I thought of making the experiment, and tried to think of some problem which I had failed to solve, and at last remembered a rider in Euclid which I had puzzled over with pen and paper, years before, and had no sooner thought of it than I was able to see the solution. This I attribute to the fact that I looked at the subject in a different light. At this time, I had much less knowledge of mathematics than at the time when the rider puzzled me. Most persons experience a difference in aptitude for mental work at different times; an individual finds that he can write, solve problems, and remember, far better one day than on another. The mere state of the health is quite sufficient to account for this; the difficulty of mental concentration of the dyspeptic, and the poor memory of the anæmic, are proverbial. The nervous force of the brain, and the rapidity with which

mental operations are accomplished, is also much greater at one time than at another; so that we can easily imagine a person, attacking a subject anew with a freshened brain, accomplishing it with rapidity. We have now to consider those cases in which the required name, or solution of a difficulty, is said to flash upon the consciousness, whilst the individual is thinking of another subject. On closer examination, we shall always find that, in the train of thought on the subject which appears to have no connection with the point to be remembered, there is really the strongest connection, as it is by means of this that some association has awakened the previous impression, or completed a process, the association forming a 'missing link,' as it were. I think that in all instances some association may be found on careful mental retrospection.

Thus, I once, vainly and repeatedly, endeavoured to recollect the name of a person in the ordinary way. The required name occurred to me when, a few days later, I was looking at a photograph of a group, the person whose name I wished to remember being amongst them. This is an example of the fact that impressions received from external objects are nearly always more powerful as reviving impressions than those originated by the action of the cerebrum. In all examples of this class of cases of 'unconscious cerebration,' the reviving impression can be found, it being remembered that there is no knowledge of the reviving stimulus except as a fresh sensory impression.

Besides this, in many cases we are able to remember what it was which prevented us from finding out the solution to a problem or puzzle; we think that it should be worked out in a *certain* way, and, having got into

this groove, of course will not solve the problem, which has to be worked out in an entirely different way. The idea may arise in various ways; the commonest are, having performed something similar in the manner we are trying to do this, and a suggestion from another person; most people must have noticed how misleading a positively-expressed wrong opinion is, when they are not certain themselves, especially if the person expressing the wrong opinion is of a superior intellect and knowledge to themselves. A student of any practical science will often be misled in this way, a fellow-student saying, 'Oh! do come and see this, it's such a fine specimen of ——,' whereas it really is not that species, but a closely allied one, which the first student would have recognised if he had not been informed as to the nature of the object he was going to see.

This practical fact is turned to good account by a conjuror, whose first object is to mislead the expectation of the audience by leading their thoughts in one direction, whilst he employs entirely different methods to accomplish the trick. He makes movements with his hands on purpose to mislead, and make people think they have found out the trick, or by some cleverly suggestive words hints that electricity is the means he employs, while he does his trick by sleight of hand.

In the same way the ventriloquist directs attention to his models, and the delusion is heightened by their mouths being made to open and shut in accordance with the sound produced, the ventriloquist having his mouth apparently shut, and being in a listening attitude.

Dr. Carpenter was the greatest advocate of unconscious cerebration, and, therefore, I will state the

reasons he gives for his belief that such a condition existed, other than those which have been already considered.

He believed that the basal ganglia constituted the *sensorium* or seat of consciousness, both for the processes of the cerebrum and external senses, 'and that cerebral changes may take place *unconsciously* if the sensorium be in a state of absolute torpor, or be for a time non-receptive as regards those changes, its activity being exerted in some other direction; or, to express the same fact psychologically, that mental changes, of whose *results we subsequently* become conscious, may go on *below the plane* of consciousness, either during profound sleep, or while the attention is wholly engrossed by some entirely different train of thought.'

The first group of cases which, he says, proves the existence of unconscious cerebration, have been already mentioned; and few are not cognizant of the fact of how persons, after trying to recollect a name, phrase, or circumstance, and, at last, having had to give up trying to remember, will have the name suddenly flash into the consciousness when they are thinking of an entirely different subject, or on waking out of a sound sleep.

I have often had this happen to myself, and have always, *when I have looked for it*, been able to find the reviving impression, as in the case already related; and so have other people when I have asked them to look for it. The following example, recorded by Abercrombie, in his 'Intellectual Powers,' of himself, would have been set down as a case of unconscious cerebration if he had not thought out and detected the reviving impression.

'Walking in the street lately, I met a lady whose face was familiar to me, but whom I could not name. I had, at the same time, an impression that I ought to have spoken to her, and to have inquired for some relative, who had lately been my patient; but notwithstanding repeated efforts, I could not recognise her and passed on. Some time after, in passing along the road a few miles from town, my eye caught a cottage, to which I had been taken about six months before, to see a gentleman who had been carried into it in a state of insensibility, in consequence of being thrown from a gig. The sight of the cottage instantly recalled the accident, and the gentleman who was the subject of it; and, at the same instant, the impression that the lady whom I had passed in the manner now mentioned, was his wife. In this case no recollection was excited by the sight of the lady, even after repeated and anxious attempts; whereas, the whole was recalled in an instant by the sight of cottage.'

This case affords not only an insight into unconscious cerebration, but also into that of the direct revival of impressions and intuitive judgments; thus, though Abercrombie was not able to recognise the lady, the idea that he ought to have inquired for some patient occurred to his mind, partial revival having taken place.

As previously mentioned, when an impression is revived by the direct process, the two ideas enter the mind together; there is no consciousness of revival. If, when I am walking along a lane, a tree of a peculiar shape brings back to my mind some scenery, I am not necessarily conscious that it is the tree which has revived the impression, but probably will be *indirectly*,

by comparing it with the scenery in the mind. (See p. 140.)

Then Dr. Carpenter cites the fact of a name often occurring after a sound sleep, and he himself remarks that this is more likely to occur after a *sound* sleep than after disturbed sleep; in short, that unconscious cerebration is taking place when there is the least amount of consciousness, and not when there is a certain amount of consciousness, as in disturbed sleep!

Every schoolboy knows that after trying to learn a lesson at night, and having gone over it a number of times and vainly endeavouring to repeat it, he has woke up in the morning, finding that he is able to repeat it easily.

These are only examples of recuperation of the nervous force by a night's sleep, and, as we should naturally expect, this is more likely to take place in those cases in which the sleep is profound. When learning the lesson, probably nearly all the nerve-force had become used up, in fixing the impression; and this is borne out by the fact that though the boy might not be able to repeat the lesson at night, in the ordinary way, he will when excited, some other emotion, as emulation, being introduced. Where is the unconscious cerebration here?

He then relates several cases, which are only examples of the direct revival, recognition, or increase in the nervous force, bringing about remembrance.

He then says that those cases in which ideas, which have passed out of the conscious memory, sometimes express themselves in involuntary muscular movements, are examples of unconscious cerebration, as 'talking-tables,' or the working of the 'planchette.'

That this does take place is an undoubted fact; but the examples given only prove the existence of a motor memory, and are instances of the direct combination of the memories. I have already given several instances of this kind (' planchette,' p. 35, and Chapter VIII.), and there shown how this automatic action will take place in many cases, in spite of the efforts of the will to prevent it.

He then states a theory, first advanced by Sir William Hamilton, namely: that one idea may suggest another by means of a forgotten link, and cites in illustration of it the following, which, however, seems to me to disprove instead of supporting the theory advanced, and to be such an excellent example of the direct revival that I will quote it in full.

'The following circumstance, which happened to the writer (Dr. Carpenter) within a few hours after penning the above sentences, might seem almost too trivial to be recorded, if it were not so exactly "to the point." His friend, Dr. Sharpey, having for years acted as one of the secretaries to the Royal Society, the writer had been in the constant habit of communicating with him on Royal Society business. But a few months previously Dr. Sharpey had resigned this post; a fact of which the writer was most fully cognizant at the time, and the recollection of which would have prevented him from applying to Dr. Sharpey on any secretarial matter. Having wished to obtain some information, which it would have been the function of the secretary to give, and meeting Dr. Sharpey at the "Athenæum," he at once asked him for it, as he had been wont to do; the mere *recognition* of Dr. Sharpey prompting this application (as a reflex action of the cerebrum), without the

conscious excitement of the idea of Dr. Sharpey's secretariat, which had originally been the concerning link. Had this idea been brought up, the writer is sure that he should have at once remembered Dr. Sharpey's resignation; more especially since he had been speaking to Professor Huxley, his successor in the secretariat, only a few minutes before in the same room, with reference to the duties of his office.'

From an examination of the above, the following fact will be noticed, that Dr. Carpenter had not firmly associated in his sensory memory the components—Professor Huxley, —— Secretary to the Royal Society—for if he had, he would have asked for the required information from *him*, but he had in his sensory memory the following impression or impressions, which may be divided into two components—Information to be obtained from ——, Secretary to the Royal Society. Then, on seeing Dr. Sharpey, the quality attached to him (Secretary of the Royal Society) was at once revived, and then the other component, the impression that he had desired information from the secretary, is remembered, and he at once asked Dr. Sharpey. The fact that he did not ask Professor Huxley for the information shows that the remembrance of his being the secretary was feeble, and not likely to interfere with the request.

This is only an example of how the qualities of objects are learnt; thus, in the sensory memory ot Dr. Carpenter the quality of Secretary to the Royal Society had become as firmly associated with the remembrance of Dr. Sharpey, as the name has with the object it represents, and it corresponds to the case of a man who, having been told that certain oranges are of

the Seville variety, comes in an hour afterwards, picks up one, and commences to eat it, the impression of his being told that they were Seville oranges not being revived, but when he tastes one he recollects the intimation previously given him.

Dr. Carpenter then goes on to say that the fact that when a person, after having worked at a subject and then left it alone, has often found, on recommencing his studies, that the subject has apparently undergone an entirely new development in the meantime, is evidence of unconscious cerebration.

This is only true of certain instances, and whether it be true or not of any particular case, depends upon whether the individual in his practice conforms to the requirements of the second law of remembrance or not; if he do and attack a subject a second time, when his mind is in a more active condition, the progress made is sufficient to account for this observation. That this is the case is shown by the example cited: it is of a clergyman who, after having made a sketch of the topics he wished to introduce into a sermon, attended to another subject, and then said that, after a week or two, *when he came to write his sermon*, he found that the topics had arranged themselves (?).

If any one wishes to try how much unconscious cerebration has to do with this, he can do so in the following manner. He should take some subject he has not previously studied, read the necessary books, and then write a short account of it. Then he should think no more about the subject for a month, and then (choosing as nearly as possible the same time of day and a similar mental condition) sit down and write another account of the subject, *without looking at the*

previous one; he will probably find himself unable to say more than a few words; then let him take out the written account and read that through first, and *then* write his second account; even whilst reading through the first, errors, improvements of description, and fresh illustrations will occur to him. It is surprising how the remembrance of a single word, or the occurrence of a single idea, will sometimes alter the whole subject; but there is no unconscious cerebration, the whole can be traced to the one idea or word, and even to the impression which revived that word or idea; and not only this, if the word or idea *be not recorded at the time it may not be again revived*, which would certainly be a peculiar action of the brain if unconscious cerebration really occurred: that after the brain had undergone a long process of unconscious cerebration, in order to discover an idea or word, the word simply flashes into the consciousness and then disappears; one would think that as it had been gained after so much trouble it would be remembered.

The following was sent by a gentleman to Dr. Carpenter, and illustrates this point:

'When at school I was fond of trying my hand at geometrical problems. One baffled me. I often returned to it; in fact, kept by me an elaborate figure. Some years after, and when the problem had not been touched by me for some time, I had been sitting up till the small hours, deciphering a cryptograph for one of my pupils. Exulting in the successful solution, I turned into bed, and suddenly there flashed across my mind the secret of the solution of the problem which I had so long vainly dealt with—the secret being a slight addition to my elaborate figure. The effect on me was strange. I

trembled, as if in the presence of another being, who had communicated the secret to me.

'Another time an algebraical sum had plagued me for a day or two. I could not get the desired result. Some weeks after, on returning from a social gathering, I retired, thinking of the pleasant evening I had spent, when suddenly it flashed across me that there was an error in the sum as set. I leaped out of bed, with the same mysterious feeling upon me, wrote down the involved expression, with the suggested correction, worked the sum, and obtained the desired result.

'Strange to say, some weeks afterwards I took the sum from the book, but could not discover what change should be made; and it was not until I found the scrap of paper upon which I had worked it that night, that I could correct the sum in the book.'

All the cases cited are similar; there is not a *single* one which shows that an unconscious mental process has taken place. As shown by the second law of Remembrance, and the accompanying examples, a point is not usually perceived until it is looked for; if Abercrombie had not discovered the reviving impression, in the case related in the early part of this chapter, it would have formed another instance of unconscious cerebration; but Abercrombie was an exceptional observer. Since I have looked for them, I have always been able to detect the reviving impression, and this may be again made use of, if the name be once more forgotten, so being turned to a practical use.

DREAMS.

Some qualification of the above must be made if dreams are said to be instances of unconscious cerebration; but I do not consider that there is true unconsciousness, and the examples given to show that they regularly take place during sleep are utterly untrustworthy.

Evidence seems to show that the large majority of dreams occur in the period between waking and sleeping—that is, in a state of partial unconsciousness.

Dreams do not appear to occur at all in sound sleepers, but to be especially common in those individuals who sleep lightly.

The law that the permanent intensity of an impression depends upon the amount of consciousness with which that impression is received, is supported by the fact that the majority of dreams are forgotten a minute or two after awaking, their evanescent character being due to the slight amount of consciousness at the time of perception.

Dreams are easily explained by the view previously laid down respecting the memories and the faculties; thus, if the greater number of the faculties be asleep, and a few awake, then the few will perceive impressions peculiar to themselves, and, as before mentioned, the fact of reviving a component will tend to revive the remainder of the impression, and so a complete picture will be formed.

We can ascertain the truth of this by thinking of a dream at the moment of waking, and then analysing it, and trying to think why we should have dreamt in

that way, the constituent impressions can often be found. The peculiar scenes which are met with in dreams are due to the blending of several impressions which are perceived by those faculties in a semi-conscious state; in dreams, the process not being limited by the action of the will, impressions may be revived with such rapidity as to make a period of several years be apparently passed through in a few seconds, and this we find to be the case.

Sometimes, in a dream, persons are able to remember what they had forgotten in the waking state; then the dream usually takes the form of someone coming and telling where the lost article is, the dreamer awaking and finding that such is the case.

In other cases a name is forgotten, and the person is told that if he go to a certain place he will see it written.

Again, in cases of recollection in a dream, everyone, who has dreamt at all, knows that individuals are especially likely to dream about subjects which have been uppermost in the mind during the day. Then the dream, having started with the required subject, arouses trains of thought and previous impressions without any interference from the will, and so may, in exceptional cases, revive the required impression.

Numerous other cases might be related, but they are all similar—namely, a perception of impressions and exaggeration of them, this exaggeration taking place because of the revival of other impressions—a number of impressions being perceived at the same time and blended together.

Some experiments have been made with a view to

ascertain the nature of dreams, and it was found that stimuli of various kinds on the special senses would give rise to dreams in accordance with them.

It is often a subject of great annoyance to over-conscientious persons to find that, in their dreams, they commit the most horrible crimes without the least compunction. This is probably due to the moral faculties having probably been more used during the day than any of the others, and so are more in need of rest; they are probably sound asleep, and so do not influence the actions of the other faculties.

Somnambulism.

Somnambulism is only an acted-out dream, and, in many cases, only a simple action is performed.

The connection between the sensory and motor memories brings about somnambulism. We can imagine that an intense impression would bring about this condition, the faculties being asleep.

It is a well-known fact that when a person has been aroused for a short period of time in the middle of a sound sleep, in order to perform some action and perhaps answer one or two questions, it is not an uncommon occurrence for him to find on waking that he has entirely forgotten being aroused in the night, and, in other cases, only remembers it as a dream; probably the impression has been perceived very feebly. This is the most probable explanation of many of the wonders which have been said to have taken place during sleep, or they may be due to the acting-out of an intense impression.

Double Consciousness.

It will probably have occurred to most persons, in a slight degree, when out of health, to fancy that they have seen or done something that they are seeing or doing for the first time, before. As this will occur not with one impression only, but with all impressions received at that time, and cases are related in which it has been a permanent condition, it is not due to an erroneous idea. It is probably due to the impressions not reaching the optic thalami at exactly the same time, and so producing a condition of mental squinting.

Many cases are related of a condition of double consciousness, and these will illustrate the fact ot memory occupying a definite portion of the brain ; and are probably due to some lesion of the track between the left optic thalamus and the cerebrum, recovery being due to an education of the right optic thalamus to a condition in which it is able to take on the functions of both, in the same way as a patient sometimes recovers his speech from the right faculty of language developing to a condition to be able to supply the necessary nervous force. The immense variety of these cases of double consciousness is probably due to different portions of the connecting track being affected ; but they all show how groups of impressions supplied by all the senses are destroyed, and not impressions belonging to one sense only, as if the impressions were remembered by a sight or touch centre.

CHAPTER XII

PATHOLOGICAL CONDITIONS IN WHICH THE MEMORY IS AFFECTED

I. General Diminution of the Memory.

In all cases in which, by any means whatsoever, there is a loss of nervous force not immediately replaceable, there is a corresponding diminution of the memory.

In cases of congenital idiocy we notice that a very feeble power of retaining impressions is usually possessed. This we should naturally expect from an examination of the brain, which is usually found to be considerably undersized. On this account, those faculties, which were under the average size, would perceive impressions very feebly, and recollect them with equal difficulty.

In idiots we have very strong confirmation of the view that the faculties of the mind are multiple, as we often find, with a general deficiency of mental power, some extraordinary capacity in one particular direction, and this can be explained by supposing that with a general deficiency in the size of most of the faculties, one of them is considerably larger than usual. We find that the function of the faculty in question, when occurring in this way, is exactly the same as in a sane person, and acts in the same way when of propor-

tionate size. Thus, we have singing idiots, who can remember tunes with the most perfect accuracy; and calculating idiots, who show a special predilection for figures, and can remember them to an extraordinary extent. Then there are others who have a special aptitude for drawing, learning words (simply as sounds, without any relation to their meanings), localities, periods of time, etc.

A case is related by Forbes Winslow of an idiot who could remember the day when any person had been buried in the parish, for thirty-five years, and could repeat with unvarying accuracy the name and age of the departed, and the mourners at the funeral. Out of the line of burials he had not one idea, and could not give an intelligible reply to a single question, nor be trusted even to feed himself.

It is the same with weak-minded individuals. We often find persons, almost idiotic in their general mental capacity, who show some special aptitude for music, mimicking, or some special kind of memory. Genius is usually only partial, a Crichton being very rare.

After any violent injury there is usually some general diminution in the power of the memory. All injuries which are violent enough to produce a severe shock are followed by deficiency in the recollecting power, for a certain time; this passes off as the expenditure of the nervous force becomes gradually replaced.

Injuries to the head are especially likely to be followed by loss of memory, and in many cases the individual says that his memory is not as good as it was before he sustained the injury.

Besides the general diminution in the power of the memory in these cases, there is often a loss of memory for a certain period of time; this will be spoken of under 'partial loss of memory.'

The next class of cases are those of functional diminution in the brain power, and corresponding diminution in the intensity of the impressions. We find in these cases that the individual can remember impressions which have acquired the requisite intensity, especially those received before the period of functional disturbance. During the period of functional disturbance, there is a want of power to retain impressions, received during that time, though previous impressions are revived; so it is quite possible to have a long conversation with a person suffering from considerable functional disturbance, without being able to detect that there is anything peculiar about him, as in many cases he will talk fluently, express opinions on various topics, and apparently conduct himself in all ways, conducing to a belief that he is in a perfectly normal condition.

Yet that same man may feel quite unable, the next day, to recollect whom he spent the evening with, and the events which took place, and might even be unable to recognise the persons he saw, even on meeting them the next day.

I have especially studied the condition of the memory in epilepsy, in which there seems to be a great loss of nerve-force, and compared it with other conditions in which there is a functional diminution in the power of the faculties to establish a memory; and have found that the above remarks apply to all other functional cases. As would be expected, when a large

faculty is present in any of these individuals, the special impressions particular to this faculty are remembered, whilst the others are forgotten. In short, it will be found that it is the functions of the faculties which are specially interfered with, the sub-intellectual processes taking place as before; if an idea be not brought before the mind by the direct revival, the individual is not able to intensify some component so as to increase the power of contiguous association, and he feels very disinclined to make the attempt.

The following cases illustrate the above-mentioned condition.

Memory in Epilepsy.

(i.) J. H. Male, $18\frac{3}{4}$.

This was a case of traumatic epilepsy, the first fit occurring when he was twelve years old.

He had an intelligent face, and spoke in a bright sensible way, giving his account very plainly.

He said his memory got worse after each fit, and was now very bad. If he were told to do anything by his father, he always forgot to do it. If he read a book, unless there was something very startling in it, he would not recognise that he had read it, the next day. He said he was not able to recognise a person directly after he had seen him. He could remember circumstances which happened, and books that he had read, before he commenced to have fits, with ease. He distinguished himself at arithmetic when at school, but he could now only calculate on paper, and not mentally, as he used to do, and had lost his liking for figures, taking especial interest in mechanical pursuits, such as fretwork.

He said he felt very despondent, and inclined to commit suicide.

Memory in Epilepsy.

(ii.) R. N. Male, 28.

The first fit occurred when he was twenty-four, without any apparent cause at the time. He had received a blow on the head when thirteen years old, and was unconscious for fifteen hours, never afterwards properly regaining his health. He was an intelligent-looking man, and gave his answers readily and plainly.

His memory, previous to the occurrence of the fits, had been very good, but had since become very bad. He said he should not be able to recognise me if he were to meet me the next day. He forgot persons ten minutes after he had seen them. He said that when he read the paper—reading about subjects especially interesting to him, as accounts of murders—directly he had finished reading, he would go into the next room and speak about what he had just been perusing, to another person, and would give quite a wrong account and keep to it until he found that he was wrong by referring to the paper. I read a paragraph to him ending with the word 'charity,' and immediately afterwards asked him what the last word was. He was unable to say. I then said, 'Was it charity?' and repeated the question three or four times, and even then he seemed very doubtful.

He said he could remember events which occurred when he was five years old and later, much better than those of the present time. He still had a very good memory for tunes, and said that, after hearing a tune in the street, he was able to go home and play it. He

whistled the air of 'Ehren on the Rhine' to me very fairly.

He said he could play any instrument without strings by ear, and by ear alone. Formerly, he had been able to play from notes, but could not now.

When the functional disturbance is very great, as in cases of sunstroke and alcoholism, we often find a complete loss of power to register impressions, but the capability of having intense previous impressions revived, retained. Thus, a person of this kind will recognise objects when shown him, and give their correct names; but if asked how long he has been in the hospital, or whether he has ever seen you before, he is unable to say, even in many cases not being able to say whether he has a father or mother.

The following case, taken from Dr. Savage's 'Treatise on Insanity,' is an example of one in which the recording cells were either destroyed or disabled in such a way as not to be able to perform their functions; so that impressions were simply brought before the consciousness, produced ideas, and at once vanished.

'A woman, forty years old, with some insanity on her father's side, and who had been exhausted by nursing a paralysed husband, had her loss of memory preceded by a fit. The loss of memory was simply loss of power to store recent impressions, her memory of the past being unaltered. She could give the German for any article, having lived some years in Germany. She could strike a note on the piano when told to do so, and also recognise the name of a note when struck. She had unimpaired power of comparing past impressions, so that she could reason in a way, and it was

evident that her ideas, both of the time of day and month of year, were formed not from memory but reason. Thus, if asked at five p.m. on a day in November, what month it was, she would at once look at the clock, then out of doors, then at the fireplace, and finding it was dark, the leaves withered, and a fire burning on the hearth, she decided it must be somewhere about October. If asked the same question five minutes afterwards, she would go through the same argument with a similar result. It was the same with deep impressions, and it mattered not whether memory was appealed to through one sense or the other. A striking illustration of her state was afforded when she was told by her friends that her husband had died. She burst into a storm of tears, but immediately stopped, and asked what she was crying about. Her general health was good.'

Nearly all affections of the brain, where there is organic disease of the brain substance, are accompanied by a loss of memory, which is often a marked feature in the disease.

II. Partial Loss of Memory.

A. *Loss of a Single Faculty.*

In aphasia we meet with the commonest condition in which there is a loss of a single faculty. What should we theoretically expect, in these cases, from an examination of the physiology of natural memory? All the faculties are concerned with the perception and recollection of impressions, so the destruction of a faculty would interfere with the above powers of the mind. But there are two similar faculties, one on each

side of the brain, just as we have two eyes and two ears; so it is necessary to explain why one is not sufficient for all ordinary purposes, there having been no interference with the impressions in the centres of memory. It must be borne in mind that a person with a large faculty is able to recollect impressions which a person with a smaller development is not able to; also the facility and capacity of recollecting varies with the sum of the nervous force. Therefore, if one faculty be suddenly destroyed, from these considerations alone, we should expect that the power of recollection for certain impressions would be almost, if not entirely, abolished; if, in addition to this, we suppose that one-half of the brain takes precedence of the other, and that the predominating faculty be destroyed, the opposite faculty will not be in a condition, besides not being large enough, to supply the requisite amount of nervous force. We find that nearly all the cases, in which an aphasic patient has recovered his control over language, have been in children, in whom the nervous force is superabundant.

We find that there is usually no interference with those processes which take place in the centres of memory.

In classifying cases of aphasia, I find that well-authenticated cases resolve themselves into the following groups:

1. *Functional Aphasia.*

This will naturally form the first group, and really forms part of the group of general disorders of memory.

Under this heading are placed those cases of temporary exhaustion of the faculties through over-

expenditure of nervous force. Most people have, at some time, felt in a condition in which the simplest words would not occur to them. In these cases, the words of least intensity are those which are the first to go. Sir H. Holland relates the following of himself:

'I descended on the same day two very deep mines in the Hartz Mountains, remaining some hours underground in each. While in the second mine, and exhausted both from fatigue and inanition, I felt the utter impossibility of talking longer with the German inspector who accompanied me. Every German word and phrase deserted my recollection ; and it was not until I had taken food and wine, and been some time at rest, that I regained them again.'

2. *Paralytic Aphasia.*

In this class are included those cases in which disease has affected the nerves supplying the organs of speech. The disease may be within or without the brain, and includes all those cases in which there is a paralysis of the organs of speech for other purposes.

3. *Intellectual Aphasia.*

As the function of the faculty of language is to perceive and recollect articulate sounds, so any destruction of it will interfere with this function. The power of recollection is affected most, as this requires the largest amount of nerve-force. If both faculties act normally, though not in a corresponding degree, partial destruction of one faculty will put the patient in a similar condition to a person with a faculty naturally of the reduced size.

Many persons have ordinarily great difficulty in expressing their ideas in words; in fact, they are not able to *think* of words. It is probable that in a case like this, any interference with the faculty would reduce the patient to an aphasic condition, with difficulty in using the simplest words.

A class of cases is met with, in which the patient has been able to understand perfectly what was said to him, and to read and write, but remains perfectly speechless. These cases are very rare, and have been called 'aphemia'; and are said to be due to some interference with the co-ordinating mechanism for articulate sounds. That such is the case seems improbable; because the patient is said to be able to use his tongue and lips for all other purposes than those of speech, it is unlikely that the co-ordinating mechanism for the production of articulate sounds is so entirely distinct from other co-ordinated movements of the tongue and lips, as these elementary sounds are only produced by the variations in the position and form of the throat, tongue, and lips.

In order to comprehend the nature of the lesion in aphasia, it is necessary to appreciate the relative parts taken by the memory and the faculties, in language. The following is the process which takes place in reading a line of printed matter, reconstructing the sentence, and writing it down:

1. Printed sentence.
2. Direct revival of previous and associated impressions, so that the mind gains ideas of the meanings of the forms representing spoken words.
3. Consideration of these words by the faculties of the mind,

and a comparison made between them and others, brought to the mind by the process of recollection, (indirect revival).

4. A decision is arrived at, as to the most suitable words, and the sentence is mentally reconstructed.

5. Co-ordination of the necessary movements by the motor memory in association with the sensory (direct connection).

6. Written sentence.

The same processes are employed in hearing a sentence and reconstructing it, as, for instance, turning a line of prose into poetry.

The part which the faculties of the mind play in these processes is indicated by 3 and 4, 2 and 5 being sub-intellectual processes. No mention is made of motor impulses, because writing is usually brought about by the direct connection; the mind, having started the process, allows it to go on without interference, being only concerned with the sensory memory.

In comparison with the above, writing from dictation, reading aloud without paying any attention to the subject, or simply copying a paragraph, give scarcely any employment to the mind, which may, indeed (as in examples previously given), be occupied with an entirely different subject, the writing being brought about by the direct connection of the memories—that is to say, we pass from 2 to 5, 3 and 4 being excluded, the impression of the word being conveyed to the sensory memory, and instead of bringing the previous impressions before the mind, excites the motor memory in connection with them.

We should theoretically expect, from a consideration of the above, that in pure aphasia the processes 3 and 4

would be those which would be especially affected, there being no interference with the processes 2 and 5 in uncomplicated cases.

It is useless to attempt any further classification, that is to say, to try to subdivide the cases of intellectual aphasia, so many varieties are met with, as there may be complicating disorders of other parts of the brain, giving rise to the most anomalous symptoms. I intend to remark on the chief symptoms met with in these cases, and show that they are in perfect conformity with the theories I have enunciated.

1. If we take a common object, and show it to the patient, he will rarely be able to name it, though he understands what it is.

Here the power of recollecting the name is lost, but by direct revival the name and associated ideas are brought momentarily before the mind. Many aphasic patients miscall objects shown to them, or use the same word continually.

2. If the right name be repeated to him he will usually nod approvingly, and shake his head if the wrong word be said.

This is proof positive that the memory for words has not entirely disappeared, for if it had, how could he distinguish the right from the wrong word ?

3. He can often read, obtaining momentary ideas as he reads, but without remembering anything.

This is due to the fact that each word revives a previous impression and idea, but, as there is no permanent fixation of the present impression, the patient has not the slightest recollection of what he has read, fixation of impression depending upon the faculty of language, and this being destroyed, no impression would

reach the requisite intensity, and anyhow no recollection could take place.

It has been said that the aphasic individual does not understand what he reads, in spite of the great interest he apparently takes in the reading, because, if asked about what he has read, even by leading questions, he is quite unable to give an answer showing that he understood even the substance. Because this is the case, it by no means necessarily follows that he has not understood what he has read: as there is no fixation of the impression, he cannot possibly recollect anything.

4. He will mostly repeat words accurately, immediately after they have been said to him, and then forget them.

In this case the processes of the direct connection take place, the exciting influence passing directly across from the optic thalami to the corpora striata, and bringing about the requisite movements in exactly the same way as he is able to copy out a paragraph from a book in his own writing.

5. He is, usually, not able to write from dictation.

Under ordinary circumstances writing from dictation is brought about, partly by the direct connection and partly by the intervention of the mind, because a person is not able to write as rapidly as the words are delivered by the speaker; if he could, as in the case of expert reporters, he would be able to write down the whole, without paying attention to what he was writing, the process being effected by the direct connection. But a person, when writing from dictation, has to retain in his mind the remainder of the sentence whilst he is writing down the previous portion, and this an aphasic individual is not able to do, as it would require that

an impression of the sentence should be retained and recollected.

6. He will often be able to copy a printed paragraph with pen and ink, changing the printed letters into the ordinary written forms.

There can be no distinct break in the chain, from the sight of the printed characters to the written forms: and more, *the writing is done with the right hand.* Yet the individual has only an indistinct conception of what he is writing. If there were a break in the cerebral processes, how could this be done? This seems the clearest evidence of a direct path from the sensory impression to the motor performance.

7. The patient will often, if the first part of a sentence be repeated to him (it being one with which he is well acquainted), instead of repeating the portion which was orally delivered to him, finish the sentence.

This is only another example of the direct association; thus, as all impressions received at one time are contiguous, the fact of saying one part of the sentence, composing the impression, excites the whole impression, and its associated motor memory, in exactly the same way as a cue given to an actor will help him to finish a speech which would otherwise come to an abrupt termination.

8. The aphasic patient usually knows whether he uses the correct word or not.

If the memory for words were entirely gone this would not be possible; but the evident annoyance or pleasure evinced by the patient, according to whether he uses the wrong or the right word, is unmistakable.

9. He cannot usually read aloud.

This is probably due to the same want of power of

remembering the word for a sufficient length of time, as is found in trying to write from dictation.

10. Under excitement an aphasic patient will often utter words which he could not have done before the excitement.

Increase of nervous force, making the one faculty sufficient, is the probable explanation of this.

B. *Loss of Memory for a certain period of time.*

Cases of this kind are comparatively common, and several are related in the chapter on Sensory Memory. Additional examples will be found recorded by Sir Benjamin Brodie ('Med. Chir. Trans.,' 1825), Carpenter, W. B. ('Mental Physiology'), Abercrombie ('Intellectual Powers'), Ribot ('Diseases of Memory'), Toulmouche ('Gaz. Méd.,' t. xix., p. 339, 1843), Hecker ('Med. Jahrbüch, für Nassau,' 1848, p. 246), Bruns ('Die Chirurg. Krankheiten,' Tubingen, 1864), Henke ('Zeitschrift für Staatsarzneikunde,' t. xxxv., p. 47); besides these, many cases are to be found scattered over the various journals.

In all these cases the process of limitation is only one of time, intense and feeble impressions being equally obliterated, to use a simile previously employed (that of likening the sensory memory to the side of a wall, which gradually becomes filled up with writing and pictures); this condition would correspond to a blot (the size of which varied in different cases), which permanently obliterated contiguous impressions, but left the remainder untouched. The condition is probably produced by the intensity of the impression destroying the recording cells. (See 'Sensory Memory,' p. 20.)

III. Exaltation of the Memory.

A. *General.*

This may be physiological, as the general exaltation of memory met with, in excitement, or under any circumstances of excess of nervous force. All men know that they are not able to remember as well at one time as at another, and it is this temporary exaltation that many mental labourers wait for, in order to perform some difficult piece of work. Habit may aid in this, as in other conditions, and a man who is accustomed to work at some particular period of the day, will often be disinclined to work at any other.

A temporary exaltation of the memory is produced by alcohol, opium, and several other narcotics.

The memory is often greatly exalted in fevers (see p. 17) and hysterical conditions, and this condition may be induced artificially in the hypnotic state. In many cases of insanity a general exaltation of the memory is one of the premonitory symptoms, and often persists throughout, the patient on recovering from the attack remembering what happened during its course.

B. *Partial.*

A partial exaltation of memory is met with in many cases of monomania, and may be found in persons suffering from fevers, as in the case of Nicolai, who, whilst suffering from intermittent fever, saw pictures of landscapes, the details undergoing constant change.

CHAPTER XIII

THE LOCALIZATION OF MEMORY

I HAVE endeavoured to show, in the previous chapters, that every impression received is registered in a certain position in the brain; that all impressions, received at the same time, form component parts of one impression, or contiguous impressions; that impressions received about the same time are registered in contiguity; how a motor memory is formed; how the faculties, by producing varying intensities of sensory impressions, develope special memories; how the sensory and motor memories become associated, indirectly and directly; how association and revival of impressions takes place; how it is that the old forget recent events, whilst remembering those of their youth, etc.

Therefore, from a consideration of the previous chapters, it will be seen that the required centres of memory must occupy a position below, and in intimate connection with, the seat of the perceptive, reasoning, and imaginative faculties. It will also be seen that they must have an intimate relation with the nerves of special and common sensation. On account of the varying states of perception, an independent arterial blood-supply will be required, and a capacity for

expansion separate from that of the remainder of the brain.

Are there any parts of the brain in a position anatomically and physiologically to fulfil the above requirements? There are, namely, the optic thalami and the corpora striata, as the seats of sensory and motor memory, respectively.

Anatomical Relations of the Optic Thalami and Corpora Striata. (See Frontispiece.)

The optic thalami are two oval-shaped masses of gray matter, situated just above and intimately connected with the crura cerebri and nerves of special and common sensation, which terminate, if not entirely, in a great part, in these bodies. Above, they are intimately connected with the cerebral hemispheres, and horizontally with the corpora striata. The optic thalami of opposite sides are connected by the middle and posterior commissures.

The corpora striata each consists of two nuclei of gray matter, the nucleus caudatus and the nucleus lenticularis, with an intervening band of white substance, the internal capsule, which also separates the nucleus lenticularis from the optic thalamus. They are situated just above the crura cerebri, with the motor tract of which they are intimately connected, and with the cerebral hemisphere and optic thalamus of their own side.

The nuclei caudati, and especially the optic thalami, are in such a situation as to be able to expand or contract without interference from, or interfering with, the remaining portions of the encephalon. Despite their intimate relations to the surrounding parts, they occupy a position, nearly exposed in the third and lateral ven-

tricles, and at the base of the brain: so any expansion of these bodies simply displaces the subarachnoid fluid in the spaces at the base of the brain and in the lateral ventricles.

An independent blood supply is necessary for an independent expansion and contraction, and this, these bodies possess. They are supplied by long thin arteries, which pass upwards through the perforated spaces, from the circle of Willis, without anastomosing either amongst themselves or with the cortical vessels, in any way. The optic thalami are supplied with arterial blood by branches from the posterior cerebral and anterior and posterior communicating arteries. Both the nuclei lenticulares and the nuclei caudati, of the corpora striata, are supplied by arteries from the middle cerebral, and the nuclei caudati receive additional branches from the anterior cerebral.

The veins from these bodies do not accompany the arteries, but chiefly terminate in the venæ galeni, which empty into the straight sinus.

I have omitted any further anatomical details regarding these bodies, as they are irrelevant to the subject of memory, and so, for more detailed information, I must refer the reader to the ordinary text-books on anatomy.

With regard to experiments on animals, those on the optic thalami have yielded purely negative results, as far as the muscles are concerned, whilst those on the corpora striata have produced general contractions of the muscles on the opposite side of the body.

Minute Anatomy of the Basal Ganglia.

The optic thalami consist of a central mass of gray matter containing numerous multipolar ganglion cells,

and a superficial white cortical portion. Large tracts of medullated nerve-fibres are found to terminate in the optic thalami, both from the cerebrum above, and the nerves below.

The nuclei of the corpora striata have a similar minute anatomy, consisting of gray matter containing groups of multipolar ganglion cells. Numerous tracts of medullated nerve-fibres are found to arise or terminate in this gray matter, from the motor nerves below, and the cerebral hemispheres above.

Here we have two bodies, conforming in every anatomical particular to the necessary requirements, and having that minute structure, consisting of masses of ganglionic gray matter, which, no matter in what part of the nervous system it is found, always has some definite function, other than that of conduction.

Comparative Anatomy.

We find that the size of the basal ganglia bears no necessary relation to the cerebrum, but is proportionately larger in the lower animals, thus corresponding to the evidence of comparative psychology, which shows that the memory in them is in the same proportion greater than the cerebral functions.

With regard to disease of the optic thalamus of one side, the only special symptom appears to be impairment of impressions received from the special senses on the opposite side of the body; and when the optic thalamus alone was affected, pain, as a symptom, was invariably absent.

Callender,[1] in an article containing the details of

[1] St. Bartholomew's Hospital Reports, Vol. V.

fifty cases of disease affecting the basal ganglia, finds that hæmorrhage into the optic thalami, or corpora striata, is usually months in proving fatal, and that the patient very rarely complained of pain.

In every instance in which pain was a symptom, the gray substance of the cerebral cortex was affected as well.

We should theoretically expect that the above would be the effect of disease of one optic thalamus. As all impressions are received in both optic thalami, we should not expect to find any very great loss of memory; what did occur was probably overlooked. Symmetrical disease of the brain is rare, and in the above cases in not a single instance were both optic thalami affected. As the optic thalami are the centres for the reception of impressions, we should naturally expect to find that the special senses on the opposite side were impaired.

The above is strongly against the theory that the optic thalami are the seats of common sensation, no pain being found when they alone were diseased. No pain would be expected from disease of the seat of memory.

As there is a special provision for the enlargement or diminution of the optic thalami, the excess of fluid passing from the lateral and third ventricles along the aqueduct of Sylvius to the fourth ventricle, and then passing into the general subarachnoid space through the foramen of Majendie, we should expect definite symptoms from obstruction in any part of this track.

The optic thalami will contain the largest amount of blood, and, therefore, occupy the greatest cubical space when a large number of impressions are being revived

at once. Therefore, an individual with a pathological obstruction to this compensatory arrangement, would dislike all excitement, in which the above would occur, or anything which would produce an increased supply of blood to the brain as a whole, especially if the brain be employed in perception.

An illustrative case is recorded by Hilton in his 'Rest and Pain'; it was related to him by the brother of the patient, not himself a medical practitioner. Hilton lays stress on the fact that it has in no way been 'cooked'; if it had been, it would probably have been unavailable for its present purpose.

'As a child, the patient was active and wiry, but very irascible in temper. As a man, he was very spare and delicate-looking. He had always some colour in his cheeks, which he retained till within a year of his death. He had a fondness for intellectual pursuits; also for turning, light fancy-work, and gardening; and a great dislike to the excitement, and especially the noise, of London.

'Indeed, at the age of sixteen, he had a severe nervous illness, with great depression, brought on by application to business in the City: it ought, however, to be mentioned that his occupation was not at all intense, and nothing would have been thought of it by ordinary men.

'His food was always of the simplest kind. Even tea, coffee and cocoa seemed to affect his head and derange his stomach; and he had an instinctive dislike to alcoholic stimulants of every kind. Though subject to coldness of the extremities, he could not bear a warm room, as it made him feel faint. Both winter and cold always affected him injuriously. He

said himself he only half lived in the winter; he seemed torpid, and would drop into a deep sleep after a meal, from which it was often difficult to rouse him at bedtime, when he seemed scarcely to know where he was.

'Excitement frequently brought on an impediment in his speech. For many years he was subject to headache, derangement of the stomach, and occasional deafness.'

On post-mortem examination, closure, probably congenital, of the foramen of Majendie was found.

This is a very interesting case, and very illustrative as far as it goes. It is unfortunate that no reference has been made to his memory, but the presumption is that there was nothing remarkable to be noticed, at any rate to an outside observer. We should not expect any noticeable defect in the memory; the cerebral hemispheres being intact, the perception and recollection of impressions could take place quite normally. Though this was the case with single impressions, as shown by his fondness for intellectual pursuits (these single impressions being revived without any increase in size in the optic thalami), if many impressions were revived simultaneously, the effect of enlargement of the optic thalami was at once seen. Excitement often caused an impediment in his speech, probably from the pressure on the corpora striata, and occasionally deafness; that is, the pressure interfered with the perception of impressions of sound.

Unfortunately, the nature of the business which upset him is not mentioned; but, with scarcely an exception, the first requirement in every business is to be keenly alive to external impressions; the salesman

of the grocer or draper would be of little use if he did not quickly and accurately appreciate the remarks and requirements of the customers: the mental process consisting of the rapid revival of previous impressions.

The opposite would be the case in most intellectual pursuits, fretwork and gardening; here the mind being concentrated on a few ideas or movements at a time, the individual would find no difficulty in pursuing them.

Again, anything which raised the general blood-pressure of the brain, as stimulants, affected him.

It is important to notice that the cerebral hemispheres were not found to be diseased, and the closure of the foramen of Majendie would in no way affect them, their expansion and contraction being able to take place exactly the same as in the normal condition, the subarachnoid fluid being displaced from the subarachnoid space into the spinal canal when necessary. It will be noticed, that, in this case, there was no interference with the functions of the faculties (cerebral hemispheres) as defined in Chapter V., p. 51, perception, recollection, the processes of reasoning and movement, being able to take place, as far as the cerebrum was concerned, exactly as in health.

Some experiments which have lately been performed with a view to ascertain the rapidity of thought, tend indirectly to prove the distinction between memory and the higher functions of the mind.

Mr. Cattell finds that $\frac{1}{20}$ second is taken to perceive white light, $\frac{1}{10}$ second to see a colour or a picture, $\frac{1}{8}$ second to see a letter, $\frac{1}{7}$ second to see a word.

It takes longer to see a rare word than one in constant use, or a word in foreign language than one in

our native tongue. He also finds that it even takes longer to see some letters than others.

It takes about $\frac{1}{13}$ second to initiate a movement, as that required to indicate when a certain colour is shown; for example, the person being experimented upon is to lift his hand when he sees a red card, but not when he sees a blue or white one; the times required for perceiving the colour, and for bringing about the movement, have been deducted before giving the above result, the $\frac{1}{13}$ second being the time required to initiate the correct movement.

It takes the following times to bring about the movements necessary to say a word, $\frac{1}{9}$ second; a letter, $\frac{1}{6}$ second; to see a picture, $\frac{1}{4}$ second; a colour, $\frac{1}{3}$ second. The mental processes take place more rapidly in adults than in children or the aged, and more slowly in the uneducated than in the educated.

Though Mr. Cattell is very familiar with German, he finds that he takes $\frac{1}{7}$ second longer to name an object in that language than in English. He requires $\frac{1}{4}$ second to translate a word from German into English, and $\frac{1}{20}$ second longer to translate in the reverse direction. It takes about $\frac{2}{5}$ second to recollect the county in which a well-known town is situated, or the language in which a familiar author wrote.

We can think of the month next to the present in half the time we require to think of the name of last month. It takes on an average about $\frac{1}{3}$ second to add two single numbers, and about $\frac{1}{2}$ second to multiply them. Those used to reckoning can add 2 and 3 in less time than others. Those familiar with literature can remember more quickly than others that Shakespeare wrote 'Hamlet.'

These experiments show that when a movement is brought about, at once, by the direct combination of the memories, less time is taken than when instigated by the mind; thus, though a letter is seen more quickly than a word, the word is spoken in $\frac{1}{9}$ second, the letter in $\frac{1}{6}$, half as long again being taken in the latter case, a motor memory being formed in the case of the word of considerable intensity. In the same way $\frac{1}{7}$ second longer was taken to name an object in German than in English, there being a definite motor memory for the Euglish word, whereas if one were formed for the German word, it was of very slight intensity.

We can think of the name of next month in half the time that we require to think of the name of last month, because the months are always repeated in regular order and not backwards; and we know that saying one component of an impression will revive the impression, and often bring about the utterance of the remainder, as is often found with an aphasic patient, the movements having been brought about by the direct connection.

Those accustomed to mental arithmetic are able to add and multiply with greater rapidity than others, the results being obtained by the process of the direct revival; and the degree to which this process may in time arrive, is shown in the case of Zerah Colburn.

With regard to perception, I have shown in a previous chapter that our knowledge of the arbitrary forms used as letters, is due to memory; so memory is required to perceive a colour, the mind receiving a colour and comparing it with a past impression. Thus, when a man is told to hold up his hand when he sees a red light, but not when he sees a blue or green one, the process, apart from that required to bring about the movement, is not one of

mere perception; for the man has to know the nature of red as a colour—that is, a past impression which is associated with the word 'red' has to be revived, and the present impression compared with it—before the mind has cognizance of it as a *red* light.

It is also found, that it takes longer to see a rare word than one in constant use, the word in constant use being at once brought before the mind by the direct revival, whilst the uncommon word has to revive its components.

Localization of the Faculties.

There is not sufficient evidence, at present, to admit of the various faculties of the mind being localized in definite portions of the cerebrum; the objections against such a result being attained by external observation have been already mentioned.

Anatomy of the Cerebral Hemispheres in Relation to Memory.

I have no intention of giving a long description of the anatomy of the cerebral hemispheres, but shall simply point out that their anatomy is in perfect conformity with the views expressed as to their functions.

The cerebral hemispheres consist of a convoluted mass of white matter internally, and gray externally, the convoluting increasing the superficial area of the brain, and the relative amount of gray to white matter.

They are intimately connected with the remainder of the brain, especially with the afore-mentioned basal ganglia.

The white matter is made up of medullated nerve-fibres, by means of which communication is made between the various portions of gray matter and with the rest of the nervous system.

The gray matter contains numerous ganglion cells and nerve-fibres embedded in neuroglia. The cells vary in shape and character, but are mostly pyramidal, with numerous processes and a large oval nucleus. The apex of the cell is, in the majority of cases, pointed towards the surface of the convolution.

The blood supply of the cerebrum is peculiar; for, after the extensive anastomosis of the large arteries in the circle of Willis, they pass to their final distribution without any further anastomosis, except of the very smallest branches in the pia mater, just before piercing the cortical substance. The veins do not accompany the arteries.

The want of terminal anastomosis is peculiar, and differs from the distribution of arteries in other parts of the body; it leads to a complete destruction of one portion of the brain when its supplying artery has become blocked by an embolus.

Such an arrangement is necessitated by the alternate actions of the faculties, and so allows of concentration of attention; everyone is aware that when thinking deeply, external impressions have no influence, whereas if there were an anastomosis this would not be possible. It seems, therefore, that there is a vaso-motor arrangement by means of which the various parts of the brain may receive additional supplies of blood, the additional blood-supply being accompanied by an enlargement of the brain substance, and a corresponding displacement of the subarachnoid fluid in that region.

The following facts are in support of the view of the increase of size in a faculty when being used.

1. Analogy with other organs; thus, when observations have been made, as on salivary glands, an increased functional action is accompanied with increased blood-supply, and increased size in the organ.

2. Under all circumstances in which we have increased arterial flow, there is increase in function, as in the first stage of alcoholic intoxication.

3. That pressure on the carotids brings on a condition resembling sleep.

4. That experiments on animals have shown that is the case. (See 'Experiments of Mr. Durham,' Guy's Hospital Reports, 1860, and Hammond on 'Sleep.')

5. That in cases where a portion of the skull has been lost, it has been found that when the man has been asleep or at rest, the scalp has shown a depression at that point; when dreaming it has been slightly raised, when awake and excited very much raised and pulsating.

It will be seen that movements are of two kinds: those originally reflex, and those which have to be learnt. The whole process of co-ordination has been described under Motor Memory, and from this it will be seen that the motor memory is established by a distinct exercise of the will. The cerebellum has been said to be the organ of muscular co-ordination, but the motor memory co-ordinates the muscles. There is one set of movements in which the mind requires special information regarding the state of the body, for their performance, and these are those required for the retention of the body in the upright position. Special information

regarding the state of the equilibrium is required before the necessary muscles can be co-ordinated. It is probable that the function of the cerebellum is to give this information to the mind, which acts accordingly. This view is supported by the anatomical connections of the cerebellum, comparative anatomy, pathological conditions, and direct experiment.

The cerebellum has intimate connections with the cerebral hemispheres and medulla oblongata. A special sensory tract of medullated nerve-fibres can be traced from the muscles to the cerebellum.

The cerebellum is found to be largest in those animals which have in any way to maintain the erect posture, and reaches its greatest proportional size in man. The bear has a cerebellum proportionately larger than that of the dog, thus corresponding with its capacity of retaining an erect position. In many of the quadrumana, especially those who habitually assume a more or less erect position, the cerebellum is of large proportional size.

In diseases of the cerebellum, a disorder of ordinary muscular co-ordination is *not* found, but there is a disorder of the estimation of the equilibrium, shown by unsteadiness of gait. The intellectual functions are not in any way affected. The observations of direct experiment may also be interpreted in the same way. Thus, an animal from whom the cerebrum had been removed lost all power of retaining its equilibrium ; but sensibility, memory, and volition did not seem to be interfered with in any way. When an attempt was made to strike it, it evidently saw the threatened blow, and endeavoured to avoid it. None of the evidence obtained was other than could be explained by a want

of power of correctly combining the movements necessary for the retention of the equilibrium. When irritated, no movements were produced, neither were any signs of pain elicited; but if any of its crura were touched acute suffering was produced.

The above experiments show also that the cerebellum does not lie in the motor tract, as after its removal the animal is still able to execute voluntary movements, and irritation of its substance produces no motor effect.

The following is a short recapitulation.

All sensory impressions, whether elaborated by the faculties of the mind situate in the cerebral hemispheres or by the sensory nerves, are permanently stored up in the optic thalami, and constitute the sensory memory. All voluntary motor impulses, whether discharged on account of information derived from the sensory memory, or when the equilibrium has to be maintained, in a large part through a special source, the cerebellum, leave a permanent modification of the cells and fibres of the corpora striata, constituting the motor memory. After the faculties have discharged their functions in establishing the sensory and motor memories, and the latter have reached the necessary intensity, they become directly combined, and act, in a large part, irrespective of the consciousness of the individual, when the appropriate stimuli are applied. The cerebral hemispheres are the seat of consciousness, and of all those processes which come under the head of voluntary; they are divided into a nuuber of faculties, each with a definite function, though closely associated, and with a corresponding influence on the mind, the influence of any individual faculty varying with its blood supply.

PART II

THE CULTIVATION OF MEMORY

IT will be seen from the foregoing chapters that the memory can be considerably improved by a careful attention to the laws of remembrance, and other physiological processes in which the memory is concerned.

As the faculties differ in individuals, any mnemonical scheme which is based upon one or more faculties will not apply to all; and many persons will find more difficulty in remembering with the aid of the scheme than without it. The following rules are generally applicable, because they are based on functions which are the same in all, and can be even utilised for the purpose of teaching animals, and very considerably in the education of children.

RULES FOR THE CULTIVATION OF THE SENSORY MEMORY.

RULE I.—*Employ a perception of sufficient intensity to allow of the future conscious revival of the impression received.*

The essence of this consists in concentration of the attention; the faculty, or faculties, must be brought to bear properly on the subject in hand, or the impression

will be only feebly received. Concentration is a quality possessed by all the faculties; the musician pays the utmost attention to a performance by one of the great artists, but might find great difficulty in listening to a sermon. The scientific man, devoted to the study of geology, finds no difficulty in observing rocks and stones for hours, with the most exclusive attention; but his thoughts would probably wander far from the game, if he were trying to watch a football match, which might be of the most intense interest to the athlete. The schoolboy, who may not trouble himself about his Latin, may be thinking very consistently of how he shall make a new boat or kite; and so on—examples might be multiplied *ad infinitum.*

It will be seen from this that a person experiences no difficulty in paying attention to a subject in which he is interested; it is fixing the attention on subjects for which there is no inclination that is difficult; and it is besides, a very wearisome and exhausting process, which ought to be avoided as much as possible by the choice of occupations suitable to individuals. When there is no opportunity for choice, and the subject in hand must be learnt, then the advice given under Rules IX. and XII. should be followed.

Want of concentration is often found as an accompaniment of functional disorders of the digestive and circulatory systems. The great disinclination for mental or physical exertion, often found in anæmia and dyspepsia, is probably due to the nervous force soon becoming expended, and there not being sufficient nutritive activity to restore the exhausted nervous system. The same may be said of the loss of concentration met with when excessive study is persevered in; in this case it is

probably due to an over-expenditure of nervous force, and plainly shows that the individual is being over-worked, especially if there be a natural aptitude for the subject. In these cases it would be absurd and most pernicious to adopt any artificial method of fixing the attention; the brain plainly requires rest—at least the particular faculties in use—whilst the others are probably under-worked. Hence the great advantage of a complete change of occupation and scene, which usually rapidly restores the individual to his wonted health. It is a great mistake to imagine that complete rest is required; the practice of music generally affords complete rest to a wearied literary man; but outdoor and athletic occupations are the best, as they answer other requirements as well.

It is of the utmost importance to acquire a habit of mental concentration; work never can be done efficiently if the student do not devote the whole of his attention to the subject.

RULE II.—*Establish a definite and decided primary impression.*

As it is important to pay attention to the subject in hand, so it is necessary to thoroughly understand, and have a clear idea of, what is to be learnt. It is especially necessary to do this, because so much depends upon the primary impression. Thus, supposing a book has to be mastered, a good plan is to carefully epitomize it, writing out the epitome in a note-book, taking care that each chapter is thoroughly understood before commencing to epitomize it. The note-book may then be used, and the subject put in a condensed form, the greater part of most books being employed to make the

remainder intelligible. This may then be learnt, and it will be found that the student will have a complete knowledge of the whole book.

A similar method must be adopted when learning a name, or a tune; each must be clearly and distinctly heard, and a person should possess a clear idea of the impression received.

It is very essential that this rule be carefully attended to; if a subject be, at first, only imperfectly learnt, it will be impossible to remember it properly, however good the memory may be. No trouble is spent in vain, in obtaining correct ideas of a subject to commence with, and many of our greatest men have said that their success was in a great measure due to an attention to this point.

RULE III.—*Each impression should not at first include too many details.*

Too little distinction is usually paid to the difference between the heads of a subject and the lesser details; a large number of students learn the whole alike, just as they are found in books; and this is a fault to be found in a great many books: the exceptions are often made more of than the examples illustrating the rule itself. This is probably due to the rule having become so familiar to the writer as to make him only see the exceptions in special prominence. The best way to avoid this unnecessary acquirement of details, is to compare several books on the subject. The main heads of a book should always be first learnt; and then, the root and trunk of the subject having been firmly established, as many branches may be added as the student is capable of remembering. This refers to

the majority of pursuits, and should be applied whenever practicable; thus, in learning French words, a large number have the same terminations as in English. Again, the substitution of one letter for another in many languages will be found to be constant; and so a large number of details may be remembered by learning one single fact. The exceptions should not, at first, be even read; but, after the outline of the *whole* subject has been mastered, the exceptions may be taken in consecutive order.

I wish to draw especial attention to this, because of the prevalence of the opposite method of teaching; thus a certain book is taken as the text-book, and so many pages are learnt, no difference being made with regard to the nature of the subject-matter; then, when the book is finished, it is gone through a second time in a similar manner, and then a third or a fourth, until the pupil has mastered its contents. Such a method of learning is at variance with all the principles of memory, and its pernicious effects are witnessed in its results, the whole being very soon forgotten; and important facts are forgotten equally with details. This may be well seen by comparing the answers of a schoolboy at school with those given by him at even such a short period as a month afterwards. The following method should be pursued, and may be expanded according to the aptitude of the student. The most elementary text-book (of not more than sixty pages if possible) should be obtained. This should be carefully read through, and a general idea gained of the subject. Another excellent method of commencing, is to read through an article on the subject in a good Encyclopædia. When the first principles have been thoroughly

mastered, a second rather larger work may be studied; but the principles, like the trunk of a tree, should always have the first prominence. The subject should then be thought over, and special points carefully studied.

RULE IV.—*Revive an impression as frequently as possible, so as to increase its intensity.*

The importance of this rule cannot be over-estimated; when practically understood, it enables the dull scholar to successfully compete with his more brilliant fellow-students.

I have already said that the conscious revival of previous impressions is a perfectly distinct process from repetition, which, in the absence of a conscious revival, simply consists in the reception of an additional impression. When an impression has been repeatedly revived it acquires great intensity, and if regularly followed by a definite set of movements, the direct connection may become so strong as to almost bring about the movement in spite of the will. Thus, in the case of a person who, finding a difficulty in rising in the morning, obtains an alarum and sets it for a certain time: when the time comes, the noise of the alarum awakes him, but he allows himself to fall asleep again without getting up; and, after this has been repeated for several days, the noise ceases even to awake him, whereas, had he jumped out of bed directly the alarum woke him, the effort of the will required would each day become less.

The conscious revival of impressions is the foundation of practical knowledge, as it is by the remembrance of other impressions that we are cognizant of

the nature of an object. Thus a microscopical specimen of any kind may be diagnosed by one, or both, of two ways; it may be recognised by certain written rules of diagnosis, or by its resemblance to a microscopical specimen previously seen, or partly by both ways. The most correct diagnosticians are those who are able to employ both methods with equal facility. Students of any branch of practical science, medicine, botany, conchology, etc., soon find that they are able to recognise a specimen without going through the processes which were at first necessary to come to an opinion—that is, they 'see it at a glance,' as it is called. Now, if a person always revives a whole as a whole, and never splits it up into components, these components will never occur to his mind, as shown in the plane-tree and clock experiments. An example of this is found in what is called 'woman's reason'—that is, she feels sure that a certain thing is so and so 'because it is'; thus a critic might feel utterly unable to say *why* a certain picture was a forgery, but feel perfectly sure in his own mind that it was not genuine, the reason being that the picture in question did not possess the whole of the qualities of one painted by ——, and so would not revive the requisite impression.

If the first three rules be paid attention to, the primary impression will, in most cases, have attained a very fair degree of intensity, not requiring a very powerful stimulus to revive it. That this intensity increases with the conscious revival of the impression can be easily proved. Thus, supposing a man has difficulty in remembering names, and he wished to remember some name; even with great attention and a clear impression, it is most probable he would not be

able to remember the name at first, probably on account of the small faculty not being able to give off sufficient nerve-force to give the impression any great degree of intensity, even when the faculty is stimulated to the utmost. But let that man write the required name in his note-book, and the next day look at the writing, and repeat this for several days; if the glance be only momentary, in a comparatively short time he will remember the name easily. Of course, in this case, the primary impression will be revived each time he looks at his note-book.

It is the same with the other varieties of memory. Thus a man may be with a fresh acquaintance a whole evening, and if his memory for faces be bad, he will not remember that acquaintance in a week's time. It may be presumed that he looked at his companion, and so there was attention paid to the primary impression. But if these two men had met for only five minutes a day for a fortnight, they would easily recognise each other.

RULE V.—*Revive the impression, if possible, without the aid of any external object, as by this means the greatest permanent intensity is obtained.*

The following will best exemplify this rule: a man wishes to accurately remember the shape of some object —say, a marble statue; he first of all looks at it very carefully, examining every point and relation of the details, and does so until he thinks he sees it thoroughly. Then he examines it as a whole, putting together what he has just learnt.

Then the greatest advantage would be got from a revival of the impression in the absence of the original.

Thus, if the next day he took a piece of paper and tried to draw from memory a copy of the image, doing so very carefully, and making corrections until he had obtained as near a likeness as he could; if this were done well, he would afterwards remember the statue in a way in which he could not possibly have done before, even if he had seen it every day for years. Still greater benefit would be derived if he took the drawing and carefully compared it with the original, making any alterations which he saw were necessary, the next day redrawing the sketch and again comparing it, and proceeding in this way until he had obtained a perfect drawing.

I know of nothing which so thoroughly establishes anything in the memory as this method of learning. The reason for this is that when any object is seen repeatedly there is a tendency to form *separate* impressions, and the essential points of the primary one are left unrevived; and so at any particular period, as shown by the clock and plane-tree experiments, the student would find himself in a difficulty, not having *any* impression of sufficient intensity to be completely revived.

Besides this, a greater amount of nerve-force is required to revive an impression voluntarily than with the aid of the object itself, as, with the latter aid, very feeble impressions indeed may be revived. A good example of this is found in the difference between reading and speaking a language; many can read a foreign language fairly well, who could not speak a sentence (apart from the pronunciation). The original object will, in most cases, revive the most feeble impressions. On this account, a voluntary revival

presupposes a very fair intensity of an impression, and, if it be revived, this will be increased.

Again, if we revive an impression voluntarily, we are able to see any deficiencies in its components. Many persons believe they know a thing perfectly well, but are found on examination to know it very imperfectly indeed. Thus, by drawing the marble statue, and comparing it with the original figure, the artist is able to see any inaccuracies, and remedy them.

The mental labour involved in this process is at first rather great, but the results obtained amply suffice to repay for the labour expended.

Let us take some more illustrations. If a man be learning a piece of poetry or prose, and directly he rises in the morning repeats it mentally to himself or writes it down, he will see whether he be cognizant of the whole or not, in a way in which he would be totally unable to do if he, at once, took up the book and again commenced learning it. The way in which this rule is practically borne out, must be apparent to any one who has tried this method of learning. Besides giving him a correct idea of his knowledge of the subject, it thoroughly establishes the primary impression.

This rule bears out a practical fact, namely, that an unheard lesson is soon forgotten.

RULE VI.—*Avoid receiving separate impressions of a subject; the previous impression should always be revived when working at a subject which has been attempted before.*

Those who have had much experience in teaching know, that amongst their pupils there are many who are exceedingly rapid learners; they can read over a

lesson and repeat it almost at once. But they also find that at the end of the session they are often beaten by the youth who takes great pains and considerable trouble in learning his lessons, giving rise to the idea that knowledge gained with great trouble is not easily lost, and *vice versâ*.

This is true enough in some cases, as far as the practical fact at present goes, but is capable of being considerably altered. It is due to this (only taking, of course, those cases where the lesson is thoroughly understood at the time of being heard, and so excluding cases of mere parroting): a boy who is able to learn his lessons very easily and rapidly usually proceeds in the following way; if he have a piece of poetry to learn he reads it over once or twice, and then can repeat it, perhaps for a day, but not in a week's time; supposing he had to repeat it again at some later period, he would learn it again, never thinking about what he had learnt before, or even troubling himself about it, and so not reviving the previous impression; if he knows it this time he has simply to do with the latterly-acquired impression. So he might go on ten or twelve times, creating a fresh impression each time (as in the clock-face experiment—nearly everyone has seen a time-piece thousands and thousands of times); as these have very little permanent intensity, he finds that he has forgotten the subject in a very short time. Thus, several of the most rapid and brilliant learners, who always answer the questions asked them in class, have failed at examination after examination, whilst their less brilliant comrades have easily passed.

Now, why is the case different with a slow learner? It is simply this: he cannot *afford* to have separate

impressions. If he did he would have to be a lifetime over learning a subject. A man who has been several days mastering a small piece of poetry, is not likely to forget his primary impression, and so all the following impressions serve to revive the first, and become associated with it.

So that the view, that if a subject be acquired with difficulty it is remembered well, is erroneous.

Men with large faculties learn anything which is peculiar to those faculties almost instantly, and retain it permanently, or nearly so. A man with a large faculty of form will see a person, perhaps only for five minutes, and recognise him years afterwards, on account of the great primary intensity of the impression. A man who can acquire languages remembers them easily in the same way. The man with a large faculty of locality will remember places with accuracy, which he visited years previously. The same applies to tunes, money, mechanics, numbers, etc. However slowly figures are acquired by most individuals, their permanency is usually very slight. Then, by the most simple process of reasoning, if a man with a large faculty acquires a subject easily and permanently, and the man with a small faculty acquires the subject only after very great labour, and then soon forgets it, the man who, having a faculty large, but not so large as to produce permanency of a single impression, will learn a subject rapidly, but, unless this impression be revived, forget it again, because the impression does not possess an intensity which allows of its easy revival.

If the primary impression were revived in these cases, the rapid learner would find no difficulty in competing with his slower companions. If instead of

taking up the book and again learning the piece of poetry, he were to sit down at a table and write out as much of it as he could remember, taking great pains to recollect as much as possible, and *then* compare it with the book, he would find that circumstances had altered, and that he would not forget the piece so easily again.

Any student who takes care to observe this rule, and revive previous impressions, will find that he will soon possess a more efficient memory than many much abler men, for Turners and Mozarts are rare, and so are a permanently revivable series of single impressions.

This rule does not apply to subjects learnt at different times by the same person, nor to the amount of attention given to the subject, as in learning a piece for recitation, where one person may learn it simply word for word, whilst another takes care to thoroughly understand the sense and the intention of the author; the latter would naturally take longer over learning the piece and remember it better; but then the same task has not been performed by each, and so does not admit of comparison. The following case, recorded by Abercrombie in his 'Intellectual Powers,' is very instructive, and throws much light on the subject:

'A distinguished actor was once called on to prepare himself in a long and difficult part at a few hours' notice, in consequence of the illness of another performer. He acquired it in a very short time, and went through it with perfect accuracy; but forgot it to such a degree immediately after the performance that although he performed the character for several days in succession, he was obliged every day to prepare it anew, not having time to go through the process of 'studying' it.

When questioned respecting the mental process which he employed the first time he performed the part, he said that he entirely lost sight of the audience, and seemed to have nothing before him but the pages of the book from which he had learned it; and that, if anything had occurred to interrupt the illusion, he should have instantly stopped.'

This actor seems to have relied almost entirely on one faculty, the faculty of form, and he was acting from the impressions, of the pages of the book, which he had in his mind, not having time to use his other faculties in the process of learning the part. This impression, not having sufficient permanent intensity, soon fell below that necessary for its revival, and so he was obliged to prepare it anew every day.

The method of learning, indicated by this rule, should always be employed in mastering arbitrary forms of any kind, such as mathematical or chemical formulæ, so that they may occur to the mind when required. A note-book should be kept exclusively for this purpose, and the formula written or printed very plainly; whenever this formula is required, it should be thought of, not by contiguity, but as written in this note-book. The contiguity of the components of a formula, is usually so weak, that, though this is the usual method of learning them, very few persons are able to remember many, and often do not feel certain of those formulæ with which they are most accustomed. The reason of this is, that there is no revival of previous impressions, except when the formula has become as familiar to the mathematician as the words used in an ordinary conversation. But, if the formula be written in a note-book, and always thought of, *as written there*,

the previous impression will be revived each time, and the student will soon see the page of the note-book, with the formula written on it, as a mental picture, and find no difficulty in remembering a large number.

Rule VII.—*If a previous impression cannot be revived, as when a subject is being studied for the first time, then a similar impression should be thought of, so that an association can be formed.*

The theoretical reasons for proceeding in this way are as follows:

All ideas and sensations, received at the same time, form components of one impression, so the impression revived will form a component of an impression, the other component of which is the perception of the subject to be learnt. At the same time, the original impression is increased in intensity, and becomes directly associated with that just received. Any past impression would do, if this were all that was required, but an impression should be revived which in some way resembles that of the subject to be learnt, and which will, therefore, aid the process of recollection on some future occasion. Thus, supposing I wished to remember that a certain person's name was Howard, I might think over my list of acquaintances, and remember that one had that name, and then think of him. Next time I saw the first man I might forget his name at first, but remember that he had the same name as an acquaintance whose name was Howard.

Again, if I wished to remember the name Middlemarsh, I might think of a house standing alone in the middle of a marsh.

Again, if I wished to remember a tune, I might

think of some air that it was similar to, or some event or emotion of which it reminded me.

The impression has not the necessary intensity for its revival, naturally, and so an aid is formed, by having another impression ready, which directly or indirectly brings the required impression to the necessary degree of intensity.

This rule is of especial advantage, when learning a subject for the first time; the first object of the student should be to detect similarities between the subject to be learnt, and the impressions already in his mind. The capability of proceeding in this way varies with the general ability and occupation of the individual; for this reason, examples, which would apply admirably for a sailor, would appear nonsense to a scientific man, because the impressions already in the mind of each were different. If we ask half a dozen men, belonging to different professions and occupations, to describe the same scene, each will do so according to the knowledge he possesses, and the comparisons which occur most readily to him, thus giving rise to those peculiarities of speech which enable an acute observer to find out the profession to which he belongs. It is best, if possible, to choose a reviving impression belonging to the same special memory class, and not only the class, but the same division as the present impression, so that the association may be as complete as possible; thus, if it were a French word which the student wished to remember, he should try to think of some other French word resembling it, in one or more syllables; that is, to find one having a similar sound, and then to connect the meanings together. If there be any similarity in sound between the English word and its French repre-

sentative, the process will be easier. A convenient way of learning a language is to make a number of similar words belonging to the foreign language into appropriate and grammatical sentences, then, as one word will suggest the next, they will be easily remembered and ready to hand when required.

RULE VIII.—*The members of an unconnected series of impressions should be associated together, so that the first may revive the second; the second the third, and so on.*

When any component of an impression is revived, there is always a tendency to the revival of the other components; but when the separate components are unconnected in point of sense, or similarity of nature, and especially if they be themselves of low intensity, the tendency may not be sufficient to bring about a revival. Under these circumstances, an association should be formed between the various members of the series, the student using if possible his largest faculties, remembering that all impressions have a tendency to revive similar impressions; thus, saying the letter G revives several words commencing with that letter, if other ideas be added, as the desire to remember the name of some person, then a number of proper names are recalled, commencing with that letter. One reason, why system and classification are so useful as aids to the memory is, that one constant idea in the mind aids the individual to remember, when the impression is not, at once, brought before the consciousness.

The following are a few methods in which this rule may be applied in remembering a list of words, a piece of prose, etc.

If only a list of words has to be learnt, as, for instance, a list of proper names, they may be classified in order of importance, alphabetically, or according to branches of the subject, and then learnt in the following manner:

Supposing that it were necessary to remember a series of unconnected words, it is rarely that such *is* required; but as it forms the most difficult case, I will take it as an example: if, for instance, we wished to remember the names on a hundred shops, in the definite order in which they occur.

Take care to notice particularly the first name, and make a stable association with it; then notice any resemblance between the first name and the second—the points of resemblance must be those which occur to the student himself, as ideas of similarity in form, or in the sound of the words; the initial letter may be the same; they may evoke similar ideas; they may have occurred before to the student under peculiar conditions; these names, or part of them, may have happened to come previously under his notice. If no point of resemblance can be seen, then some other word or idea should be introduced to act as a connecting link, and the student should then leave them and pass on to the second and third. No attempt should be made to strengthen the contiguous association; when the second and third are being associated, the first should be allowed to go entirely out of the mind, for the time being. In most cases a similarity of sound should be found, as the faculty for language is the medium through which articulate sounds are remembered, and so intensifies all similar sounds.

A similar method should be employed to associate

the third and fourth names, and so on, only taking notice of two at a time, and not in any way noticing the others.

When the student tries to recollect the series, he will find himself in an exactly similar position to Dr. Leyden and the Act of Parliament: he will be able to start at the beginning, and go right through the list, but will not be able to remember the fourth or fifth name.

The rule is of use in learning lists of words, as the various important plants belonging to a natural order, exceptions to various rules, etc.

RULE IX.—*Use as many faculties as possible, in the pursuit of any branch of study.*

When the mind is used in any way, faculties are employed, and to continue the uninterrupted use of one particular faculty, for a considerable time, is very fatiguing. Most students must have noticed the great relief felt on changing the kind of work; they may feel great difficulty in keeping awake over one subject, but, on changing to another find all their energies return. It is of especial importance for the largest faculties to be kept employed, however foreign their use may appear to be to the subject in hand. Thus, a man of a very social disposition wishes to excel in some particular subject, and to do so isolates himself, and works conscientiously at it; now, unless the impelling motive be very strong, his distaste for such a proceeding, will be so great that he will soon give up the subject with disgust. The case would have been far different if he had found some congenial friend to work with him; in most cases there is no need to talk; in fact, they may

each be occupied by different subjects. The fact of having a companion takes away the feeling of loneliness caused by the want of stimulation of the social faculties. I know men in whom this feeling is so strong that they prefer to work in the family circle, with their friends and relations talking and chattering about them, than to work alone. This latter plan is very distracting to any but those of the greatest mental concentration.

Not only is it pleasanter, but the subject is actually learnt better the larger the number of faculties used at the time, on account of the greater amount of nervous force which is given off. A social man will find on comparison that he will remember objects at an exhibition better if he have a companion with him than if he be alone, the same amount of attention being given in each case. Hence the advantage derived from teaching others, scientific and literary societies, international congresses, etc. Apart from the interchange of ideas, those ideas are received with much greater force than by merely reading, though part is due to stimulation of other faculties besides the social, and those required by the subject in hand, such as those aroused by the appearance of others attending the meeting, peculiarities in the speaker or his delivery, etc., etc.

In working at a subject which is of little interest to the student, he will find it easier to take notes as well as read, and especially to take notes in a way that gives employment to his largest faculties. Concentration of attention is merely a property possessed by all the faculties in a healthy state, and if the largest faculties be used, concentration will be easy. Thus, the artist may make illustrative drawings, the critic try

to find errors, the man who can remember facts and not words, make notes in his own language of the facts given; in short, to try to find out the most pleasing way in each particular case. It must be within everyone's experience to notice that when persons are excited, impressions received at that time are particularly well remembered.

RULE X.—*Work when the nervous force is abundant, as then all impressions will have a greater intensity.*

The gist of this is, work when you feel inclined to, and when you are in a disposition for work do not leave off on any account; a meal often destroys this ability entirely, so that it is important, if the work be urgent, and the individual feel able to do it, and is progressing favourably, not to leave off until he commences to feel tired. Working when you are in this able condition is very satisfactory, and the work produced of better quality than at any other time. Let anyone compare two pieces of his own composition, one composed when he was tired and disinclined for mental exertion and one written very rapidly, his thoughts coming quicker than he was able to write. The first would hardly bear comparison with the last. When a man, naturally a student, feels thoroughly unfit and disinclined for mental work, it is folly for him to try to force himself into working. Such a process is most prejudicial to the brain, which is 'asking for rest'; its immediate consequences are seen in irritability and want of sleep, waking up in the morning with a headache, and feeling unrefreshed, and the old adage, 'All work and no play makes Jack a dull boy,' becomes strikingly evident. I firmly believe that no good is

ever derived from forcing the brain to work. When a man feels that he is becoming mentally tired, a day in the country, a concert, or a visit to the theatre is quite sufficient to restore him, if only the first signs are appearing. It will not be waste time, either, for a man to rest or indulge in some amusement regularly, so as never to allow the slightest symptoms of overwork to come upon him; he will see the advantage in the work that he *does* do, and in most cases this will exceed the amount that he would have done if he had kept persistently at his employment, and be vastly superior in quality.

It is not the hours that a student works that are of advantage to him, or the number of books which he reads that benefits him; it is the amount he *knows* and *remembers*. Nothing causes so much slurring and want of thoroughness in work as persistent application. Perseverance, properly applied, is one of the finest qualities of the human mind. Persistent application is perseverance perverted, no time being allowed for the recuperation of the faculties. I have seen so many failures through persistent application that I wish to lay special stress on this point. I find students who have utterly failed, men of very fair ability, but their motto seemed to be 'work, work, work,' scarcely ever taking a holiday or indulging in any amusement, and hardly allowing themselves time for meals. What is the result? A prematurely old, feeble, and useless individual.

How many able, useful, energetic young men enter the various professions every year, but work so unintermittingly for the first month, that they become disgusted with their work, and have an unconquerable

desire to get away from it. Perhaps, they make a rule to work four hours every night, and keep to the rule as far as the hours are concerned. But how? Their eyes are wandering over the pages in a vacant way, reading the words, but not taking in the contents, they are constantly looking at their watches for the time, until the four hours are up, and with a sigh of relief the book is closed. In these four hours an amount of work which might be easily done by an intelligent man in a quarter of an hour, is got through. When the day of the examination comes, they feel utterly unfit, and probably fail, whilst those who have worked about a sixteenth part of the time pass.

The best and, in my opinion, the most successful plan is the following. Thoroughly mean to work, and have a liking in doing so. Having obtained the necessary books, the next thing is to make a system. For example, say two books of 300 pages each have to be mastered in three months, that is, 600 pages for thirteen weeks. If three weeks be left for recapitulation, that leaves ten weeks for 600 pages, or sixty pages a week, or ten a day. Now a man will know that he is well up to the right standard if he master sixty pages a week. Then, if he be in the medical profession, he can, after having mastered the requisite amount of book knowledge, spend the greater part of his time in the more important part, namely, in the acquirement of practical knowledge. If the requisite number of pages be thoroughly and conscientiously mastered, the student will find that he increases in the rapidity with which he performs his task, and so has more and more of his time to himself, and has the consciousness of knowing his work as well.

There is another way in which this rule is of importance; as an impression acquires greater intensity if received when the nervous force is abundant, so can an impression be revived better under the same circumstances; this gives support to the advice given by many, of the advantage of taking a week's holiday before a difficult examination. I can personally testify to the advantage of this proceeding; a student is nearly certain to overwork himself as an examination draws nigh, and so the nervous force gets to such a low ebb, that the man may make mistakes over the most absurdly easy questions, there not being sufficient nervous force even to revive strong impressions; and so a really able man may fail, often the best man up, as I have known in several instances. I am inclined to think that the examiners are often unjustly blamed in these cases, the answers given necessitating the rejection of the candidates. I have heard several answers which I feel sure were due to this cause; whereas, if a week had been spent on a bicycle, the nervous force would be excessive; and if the subject had been previously known, no difficulty would be experienced, as even feeble impressions would be revived.

This shows the truth of the popular idea of sleeping on a subject; a man is asked a question in the evening, but finds that he cannot answer it, and says, 'I'll sleep on it'; and does so, with the effect of remembering the required name or event, next morning. Probably, if he had been asked for the first time in the early morning, he would have answered correctly. Another way in which the nervous force may be increased, is to find some additional motive for action, to create a false excitement over a subject if necessary; there are many

men who attribute their success to the fact that their friends said that they would *not* succeed.

RULE XI.—*Use the largest and most active faculties to perform work with, if there be any opportunity for choice.*

The same result may, in many cases, be achieved by different faculties. A man who can only remember facts should not trouble to try to learn by heart; there are very few cases in which the substance is not sufficient.

Those who can very easily learn by heart should use concise books, as their tendency will be to learn the words and miss the sense.

A man who cannot remember details should try to classify everything, and remember a general rule for the whole, as French words, by the terminations, etc.

A man who can remember reasons better than anything else, should try to find a reason for everything, simply as an aid to memory, using a bad reason instead of none at all.

The artist should make mental pictures of a subject, if not in a position to be able to draw them on paper. An artist's sketch-book often forms an admirable diary; that is, directly he looks at the drawings he has made, the accompanying circumstances occur to his mind, and those which happened about that time, the names of the friends he was staying with, and the amusements they indulged in, all 'coming back.'

RULE XII.—*Never rely upon a weak or a small faculty alone, but use the others as assistants.*

This rule is that of the art of making useful associations.

Any one can remember anything associated with the special memories formed by their largest faculties, and if a very feeble component and a very intense component form parts of one impression, the feeble impression will in most cases be revived, when the strong impression is again brought before the mind, especially if aided by the effort of recollection. This only applies to the possessors of some large faculty, and I have found that a person of this kind, on being asked, gave answers, showing how he used the faculty. Thus, one epicure, on being asked, 'Do you remember Mrs. C—— at Mrs. D——'s dinner?' replied, 'Oh! Mrs. D——'s dinner. That's where we had that peculiar champagne; and I sat at supper opposite a dish of *pâté de foie gras* sandwiches. Ah! now I remember; she sat opposite me, a little to the left, and had a blue dress on.'

In the same way, a man with large acquisitiveness remembers easily the prices, qualities, etc., of articles in their relation to money, though he might find great difficulty in remembering other numbers.

A man with a large faculty of locality remembers places, and also events, persons, and conversations in relation with them.

With regard to an application of the rule. A very common combination is a fairly good faculty of form, with deficient language and locality, the other faculties being about average.

I find that the faculty of locality is usually very deficient in literary men, and, therefore, the variable utility of most of the artificial systems, which, as I have already mentioned, are based on the faculty ot locality, will be apparent.

It is important for the reader to bear in mind that the following examples are only given for the faculties named, and as the faculties are so numerous, and differ in individuals, minor points will have necessarily to be omitted; but if the student carefully read the chapter on the faculties of the mind, and find out his own leading characteristics, he will, with a little ingenuity, and a careful attention to the numbered rules, be able to supply these minor points himself.

It is on account of the variation in the faculties of the mind that artificial systems have, one after the other, so soon become obsolete; for though some might derive benefit, the greater number would find their labour thrown away So in reading through the following example, the student should not employ the method adopted, unless he find that it suits him individually, but should compose a system for himself after the type of the examples given.

When any of the faculties are very large in any individual, but with a corresponding deficiency of some of the others, as in the case which is related under the faculty of form, there may be, to ordinary observers, very little more than eccentricity to be noticed; whereas, if the same deficiency had occurred in a person of otherwise average ability, the absence of these faculties would render him idiotic, there being no compensating power to do the necessary work of everyday life, or even to make him distinguished in a particular branch.

The following example illustrates the possession of large form with deficient language and locality. First gain an idea of the substance of the piece to be learnt, and write this down clearly on a sheet of paper. Then write down the piece itself. Now, as the individual finds difficulty in remembering words, and also the positions of words, he would theoretically have a very hard task to learn the piece in the ordinary way, and this, I find, to be the case. Therefore, every impression must be made to suggest the next, and then the whole will be easily remembered. I will take an extract from Shakespeare for the purpose of showing how it should be done.

'All the world's a stage,
And all the men and women merely players:
They have their exits and their entrances;
And one man in his time plays many parts,
His acts being seven ages. At first the infant,
Mewling and puking in the nurse's arms.
And then the whining schoolboy, with his satchel
And shining morning face, creeping like snail
Unwillingly to school. And then the lover,
Sighing like furnace, with a woeful ballad
Made to his mistress' eyebrow. Then a soldier,
Full of strange oaths and bearded like the pard,
Jealous in honour, sudden and quick in quarrel,
Seeking the bubble reputation
Even in the cannon's mouth. And then the justice,
In fair round belly with good capon lined,
With eyes severe and beard of formal cut,
Full of wise saws and modern instances;
And so he plays his part. The sixth age shifts

Into the lean and slippered pantaloon;
With spectacles on nose and pouch on side;
His youthful hose, well saved, a world too wide
For his shrunk shank; and his big manly voice,
Turning again toward childish treble, pipes
And whistles in his sound. Last scene of all,
That ends this strange eventful history,
Is second childishness, and mere oblivion,
Sans teeth, sans eyes, sans taste, sans everything.'

On reading this over the general idea will be that the following characters are depicted:

1. Infant.
2. Schoolboy.
3. Lover.
4. Soldier.
5. Justice.
6. Pantaloon.
7. Old age.

The only incongruity in the seven is the passing from the soldier to the justice, but this can be remembered by imagining him as justice of the court-martial. Then, the ages in conformity with the text are: infant, schoolboy, rejected lover; therefore, a soldier; fights to die, but becomes famous; therefore, a justice; then, a retired general; then, old age.

No difficulty will be found with the first two lines; the third line is liable to be missed entirely out. Notice that exits comes before entrances, as the old play goes off before this new one comes on. 'Mewling and puking' is the first likely stumbling-block.

Mewling naturally reminds us of a kitten, and this is an infant *puss*; puking commences with pu.

There is an incongruity in a whining schoolboy having a shining morning face, and so the line, 'With his satchel and shining morning face,' runs a risk of being omitted; but think of 'whining and shining,' and it will be retained. 'Sighing like furnace' is rather a difficult sentence; sighing (water)—furnace (fire), remember as one impression. He is rejected for writing a woeful ballad on such a subject as an eyebrow. 'Beard' and 'pard' resemble each other sufficiently. The next lines follow naturally. He has got his honours and has now become an epicure; he has cut his beard and feels his importance, giving wise saws and modern instances after dinner. Then comes the remark, that he is now practically useless, 'And so he plays his part.'

Notice 'nose' and 'hose' in lines 21 and 22.

Now for the final consolidation of the whole by the faculty of form, which has already been more used than any other faculty in the process of writing, and in the mental pictures which I have endeavoured to draw. The student should illustrate the whole, first a rough copy, and then carefully, and keep the drawing for future reference and remembrance.

Thus, the first drawing should be of a stage; an infant, struggling in the nurse's arms, coming on; the shadow of another just leaving; and so on, illustrating each point in regular order.

In most cases, the illustrations could be made so appropriate that the words used by Shakespeare would almost occur to another person when looking at the drawing; thus, a sketch of a very thin old man

in a large pair of slippers, huge round spectacles on his nose, and a prominent tobacco pouch at his side, with very baggy clothes on, would naturally be described in the words used by Shakespeare. In learning anything, when it is not convenient to make a drawing, a mental picture may be made, bringing in all the prominent features of the subject in question. To any one with a large faculty of form, this mental picturing will come very easily, and the pictures be as easily retained; the pictures made may be the simplest possible, and require no imagination. If wishing to remember the subject permanently, it would be well to make a drawing of the mental picture on reaching home, and keep it for future reference. It is a good plan to have a scrap-book to paste all these drawings in, so as to be able to revive the primary impression if necessary.

If the student have the faculty of colour equally with that of form he can then colour all his sketches. If the faculty of colour be the largest, then he should make water-colour drawings, taking care to paint all the important parts in prominent colours. In all cases, where recollection is becoming difficult, he should try to think of the drawing and writing as being before him.

Now I wish to show how the same piece might be learnt in an entirely different manner, namely, by the faculty of eventuality. A student with a large faculty of eventuality would grasp the substance of the whole at a single reading, but in trying to repeat it would put it in his own words. The difficulty to be overcome is to get the correct rendering of the *words* of the piece. So it will be necessary to make a fact of every point through the whole piece. 'Mewling and puking' will

be the first difficulty, new words always giving trouble. But the difficulty may be got over in the following way: do not try to learn the words simply as words, but as definite actions. 'To mewl' means to 'cry from uneasiness,' and a cat mews from uneasiness, so that the recollection of the last fact will recall the first, and the first, the word. 'To puke' means to vomit. The following connection might be made (though 'mew-puss-puke' would be sufficient in most cases)—sick as a cat-puss-puke. All the facts should be shaped, not as the individual thinks they should be himself, but so that Shakespeare's words represent them accurately. Notice that there is no indefinite article before 'snail' or 'furnace.' Notice that the ballad is '*made* to his mistress' eyebrow,' not *written*. A 'pard' is a leopard, and the soldier would probably have as rough and untidy a beard as this beast; but on reaching the rank of justice he cuts it. A 'saw' is a maxim. And so on to the end.

Faculty of Language.

A man with this faculty large, will find no difficulty in learning the whole off by heart, without regard to the sense, substance, or anything else. He will be able to learn it very quickly, and, as a rule, will forget it just as quickly. The facility with which he learns prevents him from combining impressions, and, unless this be done, he will have to relearn the piece each time he says it, the impression not retaining a necessary degree of intensity; but, like all impressions, getting slightly feebler, and this *just* prevents it from being revived. But, with an exceptional development of the faculty, as has been already shown,

impressions will be revived, even from a single perception.

This is the faculty which should, *à fortiori priori*, learn words, and, if possessed largely, the individual should depend most upon it; but he should also learn the piece by the other faculties he has, so as to avoid being in the extremely awkward position of coming to a 'dead stop' when reciting or repeating a speech which has been learnt by heart. This is very likely to happen, and, when it does, the result is an utter failure.

It is particularly necessary for him to attend to Rule VI. Thus, suppose he recited a piece of prose two months ago, and wishes to recite it again in two or three days, he must especially avoid doing what I find this class of men nearly always do—that is, read over the piece once or twice the day before. He *must* revive the previous impression; he should sit down and try to write the whole piece from memory, if possible, or at any rate as much as he can remember, and then compare what he has written with the book. A man has only to try this once to see how differently he will know the piece.

With the musical faculties, the individual should try to set the piece to some sort of tune, dividing it into bars for the purpose. In the extract this is already done.

Faculty of Time.

This aids, if the piece be learnt in a rhythmical way, each few words occupying a definite period of time; then, if any word be left out, or a word of two syllables be inserted instead of a monosyllable, the fact will be immediately noticed.

Faculty of Locality.

A person, possessing this faculty large, will be able to aid his memory by it very effectually. Thus, he will find it a good plan to associate each line with an object, in some place (as his own house), with which he is perfectly familiar, the objects being taken in a certain definite order; he need not trouble to form more than a contiguous association of the lines with these objects—that is, reviving the idea of the object at the same time as the impression of the line to be learnt is received—this being quite sufficient. As an individual of this kind will remember the exact positions of the various articles of furniture with the greatest ease, when he thinks of them again with an idea of recollecting the piece of prose, the associated ideas will occur in definite order as he thinks of each object.

Faculty of Comparison.

A very great deal might be learnt by this faculty alone. Thus, the scenes may be compared with one another and with the student's own idea of the seven ages of man, or with some description he has already in his mind.

By means of vivid comparisons, the greater part of this piece might easily be learnt. Thus, the woeful lover on the one hand, and the quarrelsome soldier on the other. The severe, wise, fat justice, and the childish, lean pantaloon. The student should then think how he could, by words, illustrate these ideas (a man with large comparison is always ready with appropriate anecdotes and illustrations), and then compare the words used with those employed by Shakespeare.

Faculty of Incongruity.

Notice all the apparent incongruities and absurdities in the piece, and remember them. For example, the players making an exit before they enter. The whining schoolboy with a shining morning face. The lover making a ballad on an 'eyebrow.' The soldier full of strange oaths, and anxious to find the bubble REPUTATION; and, as a last resource, seeks even in the cannon's mouth. A fat justice lecturing a small boy. The lean pantaloon in hose a world too wide.

Imitation.

Much may be learnt by this faculty, if a good example be taken. An individual, with this faculty predominating, should get someone else to recite the piece, and then try to copy him as accurately as possible.

These are sufficient examples to show the principles on which faculties may be substituted for one another. There is scarcely any faculty of the mind which may not be made subservient, and help to learn a subject.

The following examples are more generally applicable than the above, because *most* persons find a difficulty with regard to the points named.

Substitution of Letters for Figures.

As, with most people, figures are remembered with great difficulty, an old plan has been to substitute letters for the figures, forming these letters into words, and then localizing the words.

The plan is a true example of the substitution of one

faculty for another, but has been so involved with the faculty of locality, as to make the system useless to the class of men most requiring an aid in this way—namely, those employed in literary work.

Any one, who has a large faculty of number, will find no difficulty in remembering figures; it is for those who have only a moderate endowment of this faculty that the following is written. I have also written as if the faculty of locality were weak also; but all will be remembered better, *cœteris paribus*, if it be fairly developed—that is to say, the following will be better learnt if the faculty of locality be applied as well, as shown later on, though the following has for its basis other faculties.

I used always to use the word PROFITABLE, and found it very useful; it contains ten letters to represent the nine numerals and cipher, thus: P 1, R 2, O 3, F 4, I 5, T 6, A 7, B 8, L 9, E 0.

This word contains all the most used letters of the alphabet, including the four first vowels. Said backwards, it gives ELBATIFORP, forming a connected word; this would be useful in trying to perform the mnemonical feat of saying a list of words backwards or forwards.

In learning the word, some difficulty may be found in, at once, recognising the middle letters as their corresponding numerals. To overcome this inconvenience, it will be noticed that F is the first letter of four, and stands for 4, so that a fresh starting-point can be taken from it; 3, of course, coming just before, 5 coming just after. I forms the principal letter of five. A capital B is in shape very like a figure 8.

Let us take an example of its application. The for-

mula of morphia is $C_{17}H_{19}NO_3$, which would cause most students a great deal of trouble to retain for a week, especially if twenty or thirty others were learnt at the same time. What is required to be done, is that a sentence should be formed, each word representing one of the constituents of the formula. In learning formulæ, it is always well to adhere to the rule of placing the atomic symbols in alphabetical order, as C,H,N,O, then no difficulty will be found as to which word belongs to each symbol. Each word should contain the letters corresponding to the numerals at the beginning, if possible; if this be not possible, then the word should contain no other letter of the alphabet which is found in the word PROFITABLE. The required letters in the above case are: P—A, representing 1—7; P—L, representing 1—9; and P and O, representing 1 and 3 respectively.

The following sentence would answer the required purpose and also form a sentence which is appropriate to the action of the drug.

PAin PLeasantly Passes Off.

The *pa* of pain representing the 1—7, and so on.

The above is applicable to all the drugs; but, as many persons would find great difficulty in forming appropriate sentences, I will give another method which is applicable to nearly all cases.

Take the following letters to correspond to the numerals:

S 1, G 2, W 3, N 4, D 5, T 6, R 7, M 8, B 9, L 0.

The above presents the advantages of being the most constantly-used letters of the alphabet, and the vowels not being used, these can be introduced, at pleasure, without interfering with the combinations in any way.

As an aid to learning the above letters, the following sentence will be useful:

S 1	G 2	W 3	N 4	D 5	T 6	R 7
Simply	glancing	will	not	do;	these	rules
		M 8,	B 9	L 0		
		must	be	learnt.		

Or Sygwind Tremble may be made to represent the letters, each word being made up of seven letters, containing two vowels and five of the consonants.

As being the most generally useful, the sentence will be used in the following examples.

First with regard to learning dates; they may be learnt by the substitution method, which is useful for learning landmarks, the *exact* year of which is required to be known.

I prefer the method of sentences, each commencing with one letter; the first figure may be neglected, as we can hardly imagine anyone being a thousand years wrong.

Battle of Poitiers, 1356.

3 W, 5 D, 6 T. John was defeated and taken.

As J and A do not occur in the system of letters no notice need be taken of them, and so 'was,' 'defeated,' 'taken,' give the 3, 5, 6.

The remembrance of the above depends upon the memory for facts; but form may be used as well, or substituted by drawing a picture of the scene, and writing the words beneath.

Consecutive letters may be used, as:

Battle of Bosworth, 1485.

4, 8, 5=N, M, D. Henry's *enemy* *d*ied.

Here the first three consonants (which occur in the system) are N, M, D, giving 485.

Only one word may be used, either containing the letters consecutively or intermingled with other consonants not used in the system, as:

Battle of Trafalgar, 1805.
8, 0, 5=M, L, D—*melody*.

Think of the songs after the victory, and in honour of it.

Slave trade abolished, 1807.
8, 0, 7=M, L, R—*a*m*e*l*i*o*r*ate.

Their condition was ameliorated.

Then again, the letters may be attached to the end of the important words; as:

Roman invasion under Julius Cæsar, 55 B.C.
5, 5=D, D. Juliu*d* Cæsu*d*.

Think that he did try to *seize it* (the country).

I have taken these dates at random; much better combinations may be made in many cases.

I think it is well to adopt one uniform plan. I much prefer the method of single words, with the initial letter representing the numeral, as, in this way, almost any date can be illustrated by a sentence; the words, required to make sense, being chosen with initial consonants not included in the system, or with vowels. It is for this reason that I have not adopted the usual plan of allotting the *whole* of the consonants to the different numerals, but have taken the commonest letters; and I find that the words commencing with these letters are so numerous that anything can be expressed by them, especially as the rest of the alphabet can be introduced to make sense, which could not be

done if the whole of the consonants were allotted to the numerals.

With regard to the adoption of one of these plans, those who can remember facts best should adopt the first method; those who remember words best, one of the latter ones.

This substitution method applied to learning dates *en masse*, is very imperfect. It may be usefully applied in learning dates to form landmarks to be used in the following scheme. Even then, an endeavour should be made to learn something beyond the mere date, as shown in the example—John was defeated and taken at the Battle of Poitiers.

The advantage of a knowledge of history, would be in a great degree abrogated, if any method of learning a number of isolated dates were adopted. We wish to know, for practical use, apart from examinations, not the exact date, but the approximate time of the occurrence of an event. Whereas, if isolated dates be learnt, and the student cannot remember the *exact* year, he is in a difficulty. A student of history should have the English history in his mind as a sort of 'past life.' Thus, if a man be asked, 'What were you doing in 1876?' he may say, 'Oh! that's the year I spent in Paris,' the principal events of the year, and their relation to one another, at once, occurring to him. So, a historian, when asked, 'What happened in the year 1600?' should have the principal events, and a fair idea of their relation in point of time to one another, rise up in his mind. With this idea, I have constructed the following system, which is also applicable to any subject required to be learnt in sequence, chronological or otherwise. Let—

1,	Simply,	stand	for the	period from	1000	to	1100
2,	Glancing	„	„	„	1100	„	1200
3,	Will	„	„	„	1200	„	1300
4,	Not	„	„	„	1300	„	1400
5,	Do	„	„	„	1400	„	1500
6,	These	„	„	„	1500	„	1600
7,	Rules	„	„	„	1600	„	1700
8,	Must	„	„	„	1700	„	1800
9,	Be	„	„	„	1800	„	1900
10,	Learnt	„	„	„	1900	„	2000

There are ten periods of time, each comprising a hundred years. A scrap-book should be obtained, and one, two, three, or more pages—according to the thoroughness with which the student intends to learn the history—allotted to each of the above words. One page for each word would be amply sufficient for most purposes.

Now divide each page into three portions with pencil-lines. This must be done horizontally and vertically.

The vertical lines divide the hundred years into portions consisting of thirty-three and a third years each. The space included by the two horizontal lines is for pictures to be pasted on; the space above the upper horizontal line is for remarks, events, etc. of dates ending with an odd figure; the space below the horizontal line for those ending with an even figure.

The student should next obtain illustrations of all the important events, either drawing them himself from an illustrated history, or buying appropriate pictures, or obtaining an old history and cutting them out.

These drawings should then be pasted in, in their proper places, and the date put above or below, according to whether it is odd or even. The book should be filled up according to Rule III., putting in, at first, only the most important events. A crown, or the sovereign's head, should be drawn at the date of his accession.

If the student have the faculty of locality, he will be able to learn the whole very easily, remembering exactly the position of the drawings on the pages; whether the date was above or below, and the positions of the words.

The method is equally applicable, if locality be deficient, but it is rare to meet with a person having it so deficient as not to be able to remember which picture was on the right hand, and which on the left, or whether the writing was above or below the line, whilst the picture itself is remembered. At the same time, the exercise will very much improve the deficient locality.

An association must be formed between one of the principal pictures and the key-word, by finding a picture that illustrates the word; and they are all very convenient for the purpose.

Each key-word should be written in the right-hand corner of each page belonging to it, being placed there with a number, if more than one page be used to each word, thus: Simply 1, Simply 2, etc., and no other number need be used. The student will find that, besides the association, he will soon be able to remember the words written on the different pages.

Before any exercise can be attempted with the key-words, they, themselves, must be thoroughly learnt; that is, they should each form a component with the

numerals; thus, when 'rules' is seen, the number seven should, at once, occur to the mind, by remembrance, not by recollection. The sentence can always be repeated when a doubt is experienced. One of the great disadvantages of the method, previously described, for learning isolated dates, is that the sentence has to be transcribed, so the student should try and learn the date apart from the sentence as well as with its aid.

For an example of the application of this scheme, the principal events and dates of the period from 1600 to 1650 may be taken. They are:

1. Accession of James I., 1603.
2. Gunpowder Plot, 1605.
3. Accession of Charles I., 1625.
4. Petition of Right, 1628.
5. Battle of Edgehill, 1642.
6. Charles I. beheaded, 1649.

If one page be allotted to these events, then the accession of Charles I. will occupy the middle of the page, the pictures representing the accession of James I. and the Gunpowder Plot on the left hand, and the remainder on the right, in the proportion that each should have according to the date; thus, the picture illustrating the death of Charles I. may be put very close to the margin.

The association is required to be formed between the word 'rules' and the page. It may be associated with the Petition of Right, which contained 'rules' for the better government of the country.

A good deal more may be learnt from the page than the events and their dates. It shows at a glance the relative order of events, that the period was nearly

occupied by the reigns of two monarchs—James I. and Charles I. Then, other events may be associated with the above, being written above or below, right or left, as the case may be, so that each picture shall form the nucleus of a number of events—the main points being put first, and the details gradually added. The student will be able to describe an event more efficiently than would otherwise be the case, if he think of the picture, especially if he have previously thought the picture out, and tried to explain its points. This book should always be used when reading history.

If colour be large, then paint the pictures and put all the most important events in red ink, or different coloured inks may be used for different classes of events.

The order of any series of words or ideas may be remembered by the following plan. It is of particular use in remembering the consecutive portions of speeches. Take the same words as before:

'Simply glancing will not do; these rules must be learnt.'

The student should obtain ten pictures, or engravings—if he cannot remember colour—specially suited to his tastes; thus, those who are fond of scenery, pictures of landscapes; those who prefer pictures delineating history, should obtain historical scenes. The same with those preferring pictures of animals, buildings, ships, figures, etc.

It is very important that each man should obtain pictures exactly to his liking, so as to gain as much aid from his other faculties as possible. Thus, many a sailor who would remember with the greatest ease and pleasure, pictures of ships and storms, would hardly have patience to look at a picture of the stage scene in

'Hamlet,' much less remember it; and the same applies to other classes of individuals. I cannot too often repeat that it is the *rules* which must be learnt and applied. These examples are only intended to illustrate them.

First, I will imagine the faculty of locality to be small, and so all important points will have to bear on the other faculties.

The student having obtained ten pictures suited to his taste, each picture should illustrate one of the key-words, and should do so, so forcibly, that the picture at once recalls the word. The following are a few general examples.

Simply.—Unadorned, as applied to a ship, buildings, people; only one or two objects in the picture; without design.

Glancing.—The sun throwing an oblique radiance over the picture. The moon peeping from behind a cloud. An arrow or sword glancing off a shield. A man looking over a scene. Anything implying a sudden rapid view.

Will.—Short for William, as applied to some noted person; thus, William the Conqueror. Anything illustrating strength of purpose, command, or determination. Good-will; ill-will. Obtaining one's own way. To enjoy at will. Will and testament. Will-o'-the-wisp.

Not.—Anything implying negation or failure; the reverse of prosperity; as a shipwreck, implying that the ship will *not* reach land.

Do.—Anything implying action or performance. An appeal to some higher power (Do grant this petition). As a command (Do this quickly).

These, as opposed to those. Thus, applied to a picture of fruit or dogs; *these* are very fine. Any-

thing which especially draws attention to a class of objects.

Rules.—The directions for the government of any body. Any direct or implied commands.

Must.—An expression of necessity.

Be.—Imperative; may be used as an emphasized auxiliary.

Learnt.—Expressing an acquisition of knowledge of any kind.

Appropriate pictures having been obtained, they should be pasted in a scrap-book in consecutive order, and the key-word written in the right-hand corner. The student must not take the above too literally; the only necessary requisite is to combine the key-word with the picture, and this might be done with almost any ten pictures by making associations or inventing some little story concerning them, to bring in the requisite word, and then writing it in one part of the page.

There are six letters in *simply*, so we can make six divisions of the first picture, naming certain parts with words commencing with these letters, and then taking the six words obtained and making them into a short story, or combining them into a sentence, or in any other way associating them together, so as to obtain the correct order, which, of course, will be aided by the initial letter.

The same must be done with *glancing*, and the rest of the words, finding appropriate objects for the letters, and then, an indefinite number of objects may be associated with the one leading figure; thus, if in the picture representing 'do' there be a duke, then, associations may be made with his surroundings, as

sword, hat, palace, as long as there is a definite connection between them.

If the student have locality he will find no difficulty in remembering the relations of the parts of the pictures, and so need not trouble about the above, simply dividing each picture by imaginary lines into nine portions, thus:

1	2	3
6	5	4
7	8	9

and remembering the objects found in each portion.

It is not necessary to use the key words, in order to remember a series of ideas of inconsiderable length; pictures illustrating the twelve months of the year will be found sufficient, or even the four seasons.

With locality, the pictures may be divided by imaginary lines; without locality, a short story should be made up, to describe the pictures, and the leading points of the story remembered.

Instead of pictures, buildings may be used and recollected in the same way, and this is useful for the temporary recollection of addresses. The buildings chosen should be those best known to the student. The following is a scheme for the figures from one to two hundred and fifty. The even numbers should be on one side, the odd on the other; from one to ten the

building should commence with the letter A, ten to twenty with the letter B, and so on. All the tens should be represented by churches; a column or memorial should form the centre of the odd figures, the five; a square the centre of the even figures, the six; the two a shop, the three an hotel, the four some important scientific building, the seven a theatre, the eight a private house, the nine some well-known public building. Any other series of houses may be employed for the purpose; they may be all in one street, or in different parts of the United Kingdom, or named by the student himself.

I have endeavoured in the above to suggest to the student how he may best utilize his large faculties as assistants to the smaller ones, and this is very useful when first attempting to master a subject, but subsequently all feeble impressions should be strengthened, as shown in Rule IV.

RULE XIII.—*Improve deficient faculties by a special exercise suited to each.*

Though a weak faculty should not be relied upon alone, it should be used as much as possible in association with the others; and any faculty which, though small, is necessary for the business or profession of the student, must be vigorously cultivated. The definitions of the functions of the various faculties will sufficiently indicate the subject which is necessary to exercise them—thus, trying to repeat an air which has just been heard, strongly exercises the faculty of tune; trying to find a short cut, in some district not particularly well known, by means of ideas formed of the direction of the place to be reached, strongly exercises locality;

drawing from memory, form, and so on; but in all cases the exercises should be progressive, and the whole of the rules previously mentioned should be employed. Thus, in improving the faculty of language, a sentence of one of Shakespeare's plays should be learnt every day, or some other more useful subject, which is especially required to be learnt, can usually be found in the shape of epitomes, words, etc. The sentences previously learnt, should be written out each day before the new one is attempted, until about ten have been learnt, then ten fresh sentences should be mastered in the same way, and the whole, or as much of it as can be remembered, should be written out, on the twentieth day, from memory. Columns of words may be learnt in the same way, and should be introduced into the ordinary conversation and thoughts as soon as possible; thus, in learning French, the various common objects should be mentally called by their French names. In this way, the French word will form a component with the ideas explanatory of it, and so the student will be able to think in French; and when he is able to do so, he can say that he has a fair knowledge of the language.

Again, the multiplication table may be far more easily learnt if the faculty of number be directly appealed to, at first, instead of learning a collection of bare figures which only have an artificial association with ideas of number. Correct ideas of number should be *first* obtained; the child should be taught addition and multiplication after the manner in which Bidder taught himself—nuts, sweets, and marbles being used; and he should be made to add, subtract, and multiply with the aid of them.

RULE XIV.—*When a difficulty is found in recollecting, first try to revive the impression by means of a similar one; if this fails, try to think of some associated component.*

Everyone must have experienced, at some time or other, difficulty in recollection—with many it is an everyday occurrence. It will often be found that a name, in everyday use, is temporarily forgotten, causing great embarrassment. In many cases, the initial letter of a name will be remembered, but not the remainder of the word. When any difficulty of this kind is experienced, the alphabet should be gone rapidly through, and this will often afford the necessary stimulus; but if it fail, and an idea be formed as to the sound of the word, a number of words corresponding to this idea should be considered. If this also result in failure, some associated component should be thought of, as when and how the word occurred, the various qualities of the object represented by the word; thus, the associated components of the surname of an individual are—the individual himself, his signature and any peculiar conditions under which it occurred, its resemblance to the name of some other person, its being used as an ordinary substantive as well as a proper name, etc.

RULE XV.—*Do not try to recollect in an indiscriminate way, but think of some definite impression, and revive others received about the same time.*

When no similarity can be perceived which might be available as an aid to recollection, and no component can be thought of, one particular impression must be borne in mind, and then the various circumstances

under which it was received should be called up. As we remember by single impressions, the ordinary method of recollection is very imperfect, and a great deal is left to chance as to whether an impression will be revived or not. But let a person imagine himself back in the position he was in, when the impression was received; when the surrounding details are revived, the word will in most cases be revived with it.

RULE XVI.—*When after an attempt has been made to recollect a name or circumstance, it has occurred to the mind uncalled for, at a later period, carefully notice the reviving impression, as it will often be useful for future use.*

This has been already discussed under the so-called unconscious cerebration, and a reviving impression will always be found: if it be a letter of the alphabet, then the recollection is similar to that which occurs when the alphabet is gone through systematically, with the intention of recalling the word. But it is not at all necessary that the reviving impression have any structural similarity to the impression to be revived, it may be simply a component, as in the case of a man who has a particular conversation recalled to his mind on seeing a tree of peculiar shape, the conversation having taken place near one very similar in character. Now, it will be found in practice that the remembrance of this tree will serve to recall that conversation when required; in fact, before, when no special points or components (by means of which the knowledge might be recalled) were remembered, it was in a similar position to a number of books locked up in drawers which only opened if the correct knob were pressed, whereas, if the reviving

impressions be noticed, and by classification, etc., *made*, a key is possessed which makes the knowledge available at any time.

RULE XVII.—*Notice which faculty will revive the required impression, and try to excite it, so that its influence shall predominate in the mind.*

An endeavour should be made, to be as nearly as possible in the same mental condition as when the impression was received, if this can be remembered. Then the faculty itself should be excited. Thus, if a proper name be the impression to be revived, the faculty of language may be made to predominate by the revival of other words, the idea of recollecting the word itself being temporarily put aside. Those words which are in any way similar to the one to be revived should be thought of, as in the case of a word belonging to a foreign language; several words from that language should be written down or spoken aloud, taking, as a clue, the ideas possessed of the word to be remembered. It is the same with other faculties; a tune will often be recollected after several others have been hummed, when at first there was no idea of the melody. In all cases the idea of recollecting some impression should, for the time being, be allowed to pass out of the mind. Any way in which the nervous force may be temporarily increased will form an aid to recollection; all circumstances which were mentioned as favourable to perception are also favourable to recollection.

Rules for the Cultivation of the Motor Memory.

Rule XVIII.—*Obtain a correct and definite idea of the movement to be performed, and then carry it out, at first very slowly.*

It is absolutely essential in learning any movement that a correct idea be formed concerning it. Many men when wishing to execute any movement leave the whole more or less to chance, as in riding or dancing, and so contract the worst habits. The opposite to this is perhaps worse—namely, learning how the movements should be executed by previously studying a book, and then trying to carry out the ideas formed. These are almost certain to be erroneous: from the nature of the motor memory, no movement executed by it can be ascertained to be correct, except through the sensory memory, so that, in many cases, a man is able to perform an action which he is absolutely unable to explain; he cannot say how he does it.

The best way of proceeding is as follows: the student should go to a teacher who is able to show him exactly what should be done, and should learn the constituent parts of the movement, taking care that he has complete control over his actions. When he is able to execute the movement correctly, no matter how slowly it be done, he may commence to leave its performance to the motor memory, and then rapidity will soon come by practice.

When the direct combination of the memories is thoroughly established, it is important that it should not be interfered with, as the movements then become

stiff and awkward. Many a person would find great difficulty in executing some of the commonest combinations of movements if each were the result of a voluntary effort.

RULE XIX.—*Learn, and repeat movements when the nervous force is abundant.*

As the motor memory, like the sensory, depends upon the emission of nervous force, when this is abundant a stable motor memory will be much sooner constructed. When the nervous force is abundant an aptitude will be felt, and it is *then* that any especial difficulty should be encountered. The opposite is equally true; and when the nervous force is low, the individual feeling tired and disinclined to work, the efforts are worse than useless. This is especially noticeable in those cases in which children are forced to try to learn some movements, as those necessary for playing on the piano or violin, and make scarcely any progress, even after hours of practice; the probability is that if about one-sixth part or less of the time had been employed, the progress would have been greater.

RULE XX.—*Do not allow the motor memory to establish any movement which is not at first under perfect cognizance of the mind.*

This rule applies to the formation of bad habits in the way of movements, tricks which are in many cases quite innocent, in others cause great annoyance. I will give an example: In boxing, the left arm is moved backwards and forwards several times until an opportunity is seen for striking a blow. A knowledge will be obtained of the apparent movements employed,

but repetition of movements is extremely likely to occur. Thus, three feints are made and then a blow is struck, and, this continually occurring, the adversary soon finds out his opponent's method of procedure, and acts accordingly. If a stable motor memory have been formed, great difficulty will be found in striking a blow at the first, second, or third movement, or in missing the fourth without making one. So that it is necessary to carefully consider the nature of the motor memory in relation to a movement to be performed, and to avoid acquiring any habit of this kind.

RULE XXI.—*When an erroneous special motor memory has been established, no attempt should be made to unlearn it, as it is called, by repetition of the correct movement; but this should be learnt with the aid of some slight premonitory trick, as a separate and distinct action.*

When some habit has become established by the motor memory, as some erratic movement in dancing, it is often extremely difficult to break, the old movement being performed directly the attention is allowed to wander. It is best in these cases to adopt such a modification as will enable the student to adhere to the correct movement, the essential difference being borne in mind. Each time the corrected movement is performed, some other slight action should be executed as well—something which is quite trivial and unnoticeable, as bending up the forefinger into the palm, slightly biting the inside of the lip, etc. This will soon become strongly associated with the correct movement, and the two will be carried out together; the premonitory trick being performed just before the corrected movement, a

special motor memory will be accordingly developed, and the corrected movement executed with ease. But, as I have shown when speaking of the direct combination of the memories, when a sensory memory impression is continually followed by the execution of a certain movement, the one will soon naturally follow the other, at last, without even cognizance of the mind. It will be seen, from this, that the establishment of some special memory impression, to be continually followed by the requisite movement, will be quite sufficient; thus, let the student continually excite some impression, as a number or particular idea, just before the execution of the movement, until it has become properly established.

RULE XXII.—*When a movement has to be performed, no idea of negation of some other movement should be allowed to enter the mind.*

The advantage of attending to this rule is very great, and the reason for it is shown in the direct combination of memories which occurs when any movement is being acquired. Now, if a sensory impression, which is usually followed by some particular movement, be revived, that movement is very likely to occur, especially if the person be using his muscles at the time. The seat of judgment, reflection, and the other conscious processes of the mind, is in the cerebral hemispheres; the motor memory, except through a sensory impression conveyed to the mind, affords no information of its workings, and so the most curious blunders are made. Thus a man writes a letter, having in his mind the necessity of *not* making some particular remark, and finds, to his astonishment, on

reading the letter, that he has made the remark, that he has used the affirmative when he intended to use a negative. So instead of allowing an idea of 'I must not do this' to be in the mind, an idea of 'I must do that' should be substituted. This should especially be borne in mind when writing an examination paper. I have heard of some very curious and outrageous blunders, and feel sure that many of them must have occurred in the above way, as there is, usually, not time to read over what has been written; and it is impossible for an examiner to say, in many instances, whether the mistake be due to ignorance or a slip of the pen.

In the same way, if, when a movement has to be corrected, the idea of 'I must not make the old mistake' enter the mind, it is extremely likely the mistake will be made.

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